Hobbies

THE MODERN BOY'S LIBRARY

SOMETHING TO MAKE
THE OUTDOOR BOY
THE BOY'S WORKSHOP
HOBBIES

Edited by Eric Wood

Hobbies

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With Eight Plates and Many Illustrations in the Text

New York
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EDITOR'S NOTE

THE MODERN BOY'S LIBRARY has been designed to include volumes on every subject in which the boy of to-day is interested—which means that eventually there will be but few subjects not dealt with! For the modern boy is keen to know about everything that happens; anxious to try his hand at the making of things; the joy of creation is behind all his dreams.

Each of the books in the Library has been written by men—there are nearly as many contributors as there are chapters!—who are experts in their own spheres; and, while every endeavour has been made to reduce even the most intricate subjects to simplicity, it must be remembered that some subjects are not to be treated in the style suited to the mentality of the kindergarten; and, after all, these books are not intended for the kindergarten. Moreover, it is worth remembering that the value of books lies in their knowledge-giving quality. We do not read books merely because they are there to read; we study them in order to get to know something of which we were ignorant before. There are many things in the volumes of this Library that the average boy does not know; they are here for his instruction, in language as simple as is possible consistent with accuracy.

To give something for the boy to do, to know, to enjoy—that has been the threefold object behind the compilation of these books.

Contents

HOBBIES

Section I
COLLECTING AS A HOBBY

STAMP COLLECTING AS A HOBBY

IN these days, when every petty state is a stamp-issuing country, it is no difficult task to become a stamp collector and to amass quantities of the vast number of postal issues that have done, and are now doing, duty. The way of a philatelist lies on higher ground.

The novice has very little difficulty in starting a collection.

Then he meets a real philatelist and brings out his album for admiring comment; he will learn a lot of things, and if he is half-hearted in his pursuit of the goddess Philatelia, his disgust may cause him to abandon stamps at once and for ever. Should his enthusiasm be strong enough to bear the adverse criticism passed on the jumble of specimens that he has brought together, he may mend his ways and begin to collect and think philatelically.

In the modern type of fixed album one's worries grow with the number of stamps. A young collector finds that he quickly fills the pages devoted to France, Germany, Great Britain and the United States.

I went through many troubles before I arrived at a solution of all album difficulties—the loose-leaf blank album.

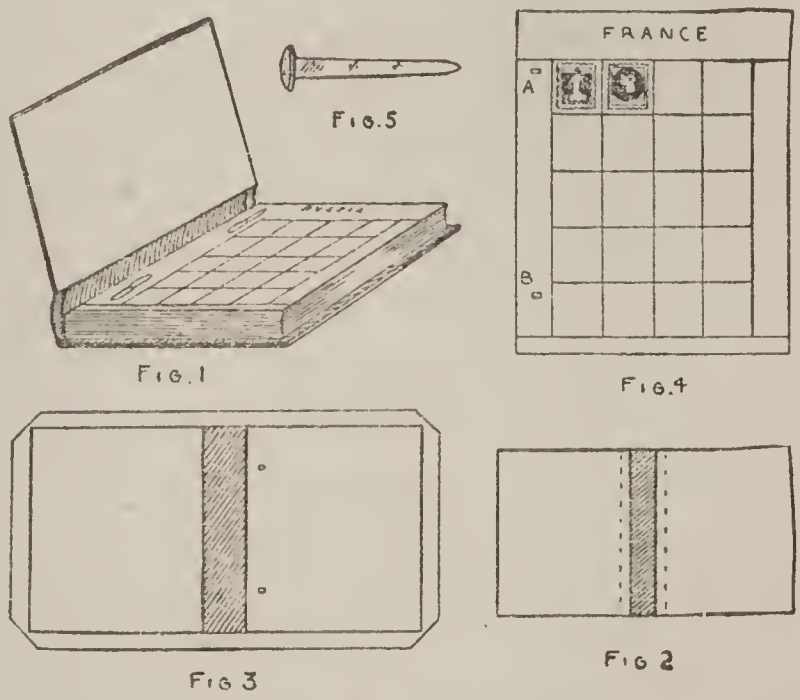
To make the loose-leaf album shown by Fig. 1, there are required two pieces of thick cardboard $7\frac{3}{8}$ in. by $5\frac{7}{8}$ in., some coloured blind linen, sufficient white foolscap, and two paper fasteners $1\frac{1}{2}$ in. long. Join the cardboards 1 in. apart, by gluing on a strip of the linen, as in Fig. 2. When dry, lay the boards on the remaining linen and cut a piece $\frac{3}{4}$ in. larger all round, trimming off the corners, however, at an angle, as in Fig. 3. Glue the linen all over, and rub well down on the boards, turning over the edges. Paste two pieces of foolscap $7\frac{1}{8}$ in. by $5\frac{3}{4}$ in. inside.

The leaves are 7 in. by $5\frac{1}{2}$ in. and are ruled, as in Fig. 4, the name of the country being lettered in. The spaces for the stamps should be $1\frac{1}{8}$ in. by 1 in. Two small slits are made in each leaf, as at A and B, also in one side of the cover, as seen in Fig. 3. Through these the paper fasteners (Fig. 5) are inserted. When the leaves are in, they are secured by turning down the fasteners, while by turning up the latter other leaves may be added at any time, or the arrangement changed at will.

In this album there is absolutely no printed matter whatever; the collecter must supply that, either with his pen or by buying printed and gummed labels bearing names of countries, issues, dates, values, etc. The leaves are printed with a decorative border enclosing a quadrille pattern of tiny squares formed by faint lines which cross the page vertically and horizontally, and offer much assistance in the arrangement of specimens. About eighty of

these leaves are enclosed in a loose cover of cardboard with a flexible linen back. The latter, together with the leaves, is inserted in the binder, which, by means of a hidden steel spring, clips the lot together as firmly as though they were glued and sewn. By bending back the covers of the binder the leaves are released without any trouble.

The possessor of such an album is bound down by no limits of space.



A Loose-leaf Stamp Album

Every stamp inserted in the album should be, as nearly as possible, a perfect specimen. It should first of all be untorn. If it is a perforated stamp none of the teeth should be missing, and if imperforate it should possess wide margins on at least three sides. The reason for this is fairly obvious; many stamps are absolutely identical in appearance, save for the fact that some possess perforations, while others lack this means of separation. In the majority of cases the imperforate stamps are by far the most valuable, and it would be an easy matter to cut off the teeth of the cheaper variety and pass it off as the valuable stamp were it not for the fact that collectors insist

on wide margins (about $\frac{1}{10}$ of an ineh) on three sides, so that they can be sure that the stamp never was perforated.

The perfeet stamp must be spotlessly elean, it must bear no stains, no greasy finger-prints, its eolours must be clear and unfaded, and if it has been eaneelled it must not earry a heavy, blotchy post-mark.

Mueh may be done to restore soiled stamps to their pristine eondition. A wad of eotton wool dipped in benzine will remove grease stains and many varieties of dirt, and will not injure the most delieate eolours. Many old stamps, espeeially those printed in red, fade to a dingy brown, this being the result of oxidation. If these are painted with a solution of hydrogen peroxide, the original eolour will gradually return. Creased stamps may be straightened by moistening the baek and ironing between glazed eards.

The majority of used stamps come to the young philatelist with a portion of the envelope adhering, and this must be removed before the speeimen ean be inserted in the album. The method adopted used to be to float the stamps faee upward in a saueer of warm water, but this would be suieidal in dealing with many modern stamps and all modern British Colonials. Stamps eost very little to forge, and elever imitations may sell for many pounds. Not only have philatelists been defrauded, but governments have lost money through sueh dishonest praetiees. Some years baek a common triek with the faking fraternity was to take the postmark out of a used stamp with aeid and use it again. This did not affeet the appearance of the old engraved Colonials, which could be

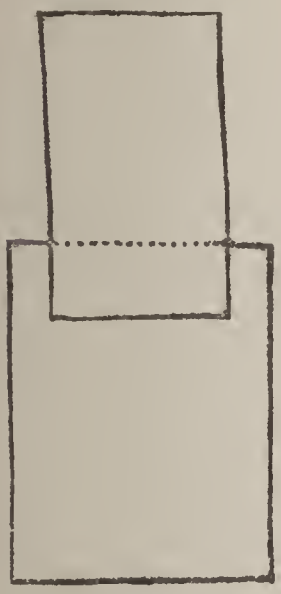


Fig. 6
Right Way to Insert Stamps

boiled without suffering loss of colour; but as the Government discovered the fraud a change of method of printing was devised, and Colonial stamps are printed in a variety of ink that will "run" at the merest suspicion of dampness. Some are even printed on paper coated with a surface of chalk that the mere touch of a finger will cause to smudge, and they need a protective sheet of tissue paper to protect them from friction in the album.

It would, of course, be foolish to soak such "fugitive" stamps in warm water, and one has to be very careful in removing the adherent envelope. A piece of clean white blotting paper should be well damped and covered with a piece of white unglazed paper. On this the stamps may be laid face upwards and covered with a sheet of glazed paper. The whole should then be placed between the folds of a newspaper and weighted with a couple of heavy books. At the end of half an hour the paper at the back of the stamps will have absorbed sufficient moisture and will peel off quite easily, leaving the stamps almost dry.

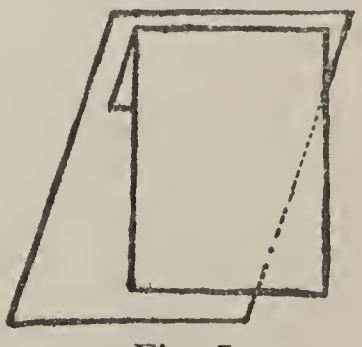


Fig. 7
Right Way to Insert Stamps

Of course, the only medium for inserting stamps in an album is the transparent mount, but many young collectors have but hazy ideas how to use it. It is a tiny strip of paper (measuring

usually ¾ in. by ⅜ in.) gummed on one side, and can be purchased in airtight tin boxes at 6d. per 1,000. These mounts should be creased to form a hinge, one flap of which should be twice as long as the other Fig. 6). Moisten the shorter portion and press it on to the top of the stamp, so that the fold is as near as possible to the top of the stamp without showing above the perforations. Now slightly moisten the other end of the hinge at its extreme end and affix it to the spot chosen in the album page (Fig. 7). A stamp so treated may be turned over on its face (in order to examine watermark) without bending the specimen or injuring the perforations. The stamps may not lie flat immediately they are mounted, but a night in the album will put that right. Do not be tempted to press them down with the finger, or damage will surely result. Do not mount unused stamps near a fire or in a hot room; they curl abominably, and make mounting a most difficult task.

The only possible system for arranging the stamps on the album page is, of course, sequence of issue and order of value. I must here insist on the absolute necessity of a stamp catalogue to a beginner; it is the only possible source from which he can derive the necessary information about the order in which the stamps appeared.

Let us take, for instance, a simple country like Southern Nigeria, and see in what order we are to arrange its postal issues. Turning to our catalogue, we find it first issued stamps in 1901, and that in 1914 it was united with Northern Nigeria to form the great Province of Nigeria. The issue of 1901, which must come first on the album page, bears the Jubilee

portrait of Queen Victoria, and contains nine values from ½d. to 10s. These will require two lines in the album, and will be followed by the Edwardian set of 1902, which is very similar in design and values.

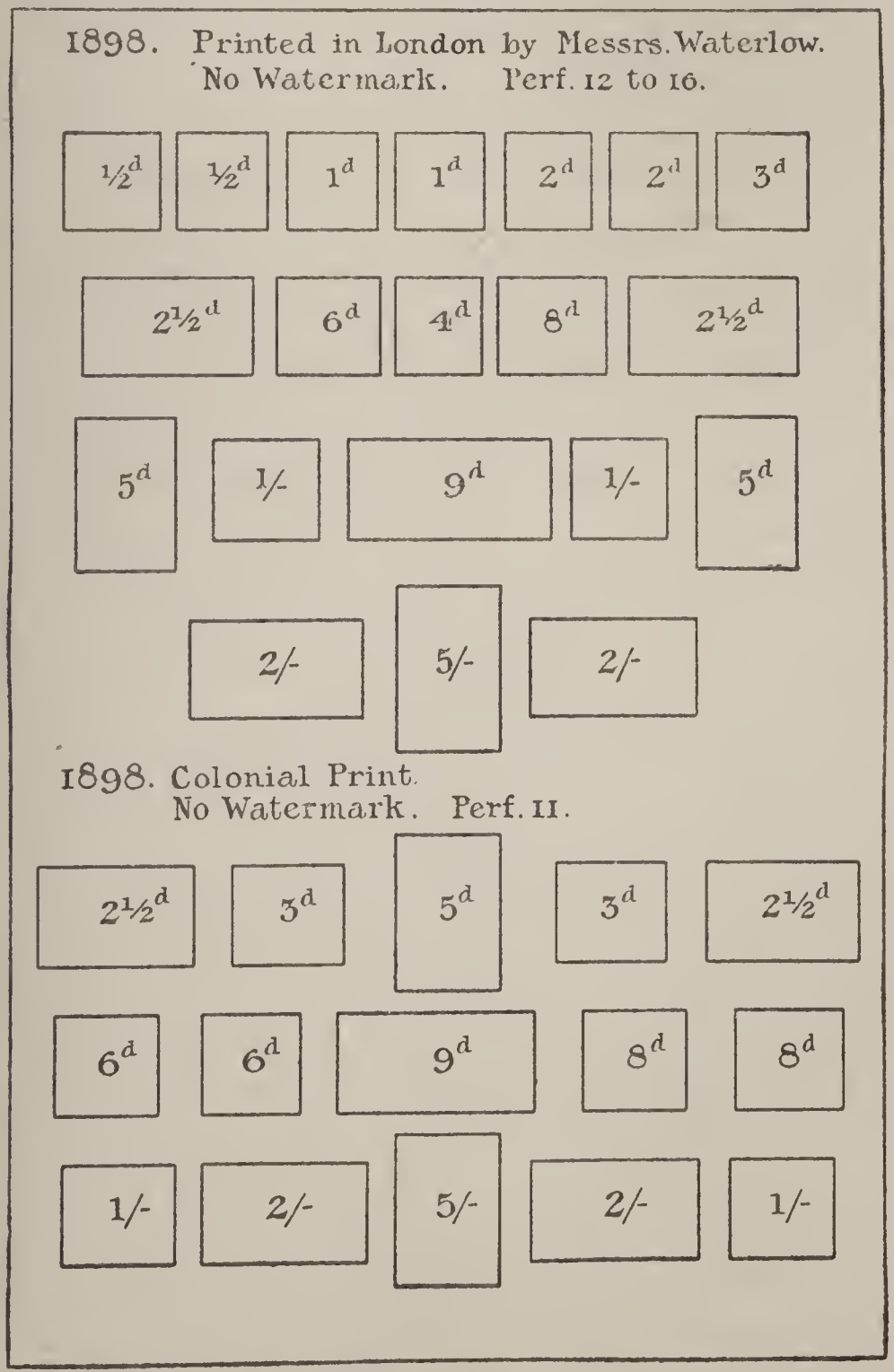


Fig. 8.—A Specimen Page in an Album

An apparently identical set appeared in 1904, but these bear what is known as the " multiple " watermark, and others possessing only a single imprint of the " Crown C A."

In 1907 a scheme was devised by the Colonial Office by which all stamps of our possessions should conform to an official colour scheme (i.e. ½d. green, 2d. grey, 4d. black and red on yellow paper, 6d. dull and bright purple, 1s. black on green paper, etc. etc.), and in this year we have a set for Southern Nigeria in these universal colours, which must follow the multiple watermark set in the album ; and, lastly, in 1912 we have the Georgian set, which brings the separate issue of the Colonies to a close. Southern Nigeria would be followed by Northern Nigeria in the album, and the single set at present issued for Nigeria would occupy the next page and form a link between the neighbour Colonies.

Unless a beginner has seen a set mounted in a blank album he may be somewhat at a loss to know how to proceed. He may insert his stamps in chronological order, and then, after a lapse of a few months, he may find that he is a little uncertain as to " which is which." This difficulty is avoided by the majority of collectors by " writing up " each page as it is completed. At the minimum, each issue should be preceded by a statement of its date of issue, perforation, watermark and method of printing. Many philatelists are not content with this, but insert on the album a complete history of the issue, and, in the case of irregularities, of every stamp. This will include artist, engraver, printer, paper and date when the issue became obsolete.

A point that must not be neglected is the "balance" of stamps on a page. I have always noticed that a page crowded full of stamps is never so effective as one in which blank spaces occur. The blank album page will accommodate six stamps horizontally, and about nine vertically; but this does not mean that the page is to be arranged in draught-board fashion. To make my meaning clear, let us take, for example, the familiar pictorial set of New Zealand issued in 1898. These stamps were first printed in London by Messrs. Waterlow, and, later, the plates were sent to the Colony. The two printings may be distinguished by the different gauge of the perforations, of which more later. Let us suppose we have the following stamps (and shades) to insert :

London Print : ½d., ½d., 1d., 1d., 2d., 2d., 2½d., 2½d., 3d., 4d., 5d., 5d., 6d., 8d., 9d., 1s., 1s., 2s., and 5s.

Colonial Print : 2½d., 2½d., 3d., 3d., 5d., 6d., 6d., 8d., 9d., 1s., 1s., 2s., 2s., and 5s.

We have here three distinct sizes of stamps—normal, horizontally long, vertically long. If we insert these strictly in order of value, we shall get a most ill-balanced page, so I append a diagram that may help you in arranging other countries whose stamps are not all of the same size.

When Great Britain placed the famous "Penny Black" in circulation in 1840 the stamps were issued in unbroken sheets, without other means of separation than the scissors of the post-office clerk. Seven years later trial was made of a perforating machine invented by Henry Archer, which, however, proved

unpraetieal, and stamps with the Areher perforation are exeeedingly rare. In 1854 another maehine was tried whieh proved a eomplete sueeess. The perforating apparatus eonsisted of a horizontal row of needles running the entire width of the sheet, with short vertieal rows meeting it. This maehine would perforate the top and sides of a row of stamps at one operation, and the sheet was moved upward into position for the next row, which reeeived its vertical perforation at the same time as the row above was perforated horizontally along the base. The type is known as the type machine, but many Colonial issues have been perforated by a "single line" machine, whieh possesses but a single horizontal row of pins. In sueh a machine it was necessary to turn the sheet sideways after it had been perforated vertieally, so that the operation eould be completed.

Other methods of separating stamps were in use in other eountries. Rouletting is the most important of these. A small hand-wheel, the edge of whieh bore sharp teeth, was run along between the rows of stamps. This removed no paper, but made small euts whieh enabled the stamps to be easily separated. Various rouletting maehines have also been in use whieh have given us the following types:

Straight roulette — – — – — – — –

Rouletted en are ⌒⌒⌒⌒⌒⌒

Rouletted en seie (saw tooth) ΛΛΛΛΛΛ

Rouletted en serpentine ∿∿∿∿∿∿∿∿∿∿∿∿

Rouletted en points (diagonal euts)

Rouletted en losange (unjoined diagonal cuts) VVVVVV

Rouletted in half squares ⊐⊐ ⊔⊔

The stage at which a person begins to measure the perforations of his stamps marks his passing from the deserts and trackless wilds of mere collecting to the ordered and bounded realms of scientific philately. I have often been asked by young collectors, "What's the use of measuring perforations?" Well, in many cases the size of these little holes is all that distinguishes a rare and scarce issue from a common one. As in the case of the New Zealand pictorials, it enables us to pick out the London prints from the Colonial emissions; and it may, in the case of the two-cent Ceylon of 1872, change the value of the stamp from £7 10s. to 1s. 3d.

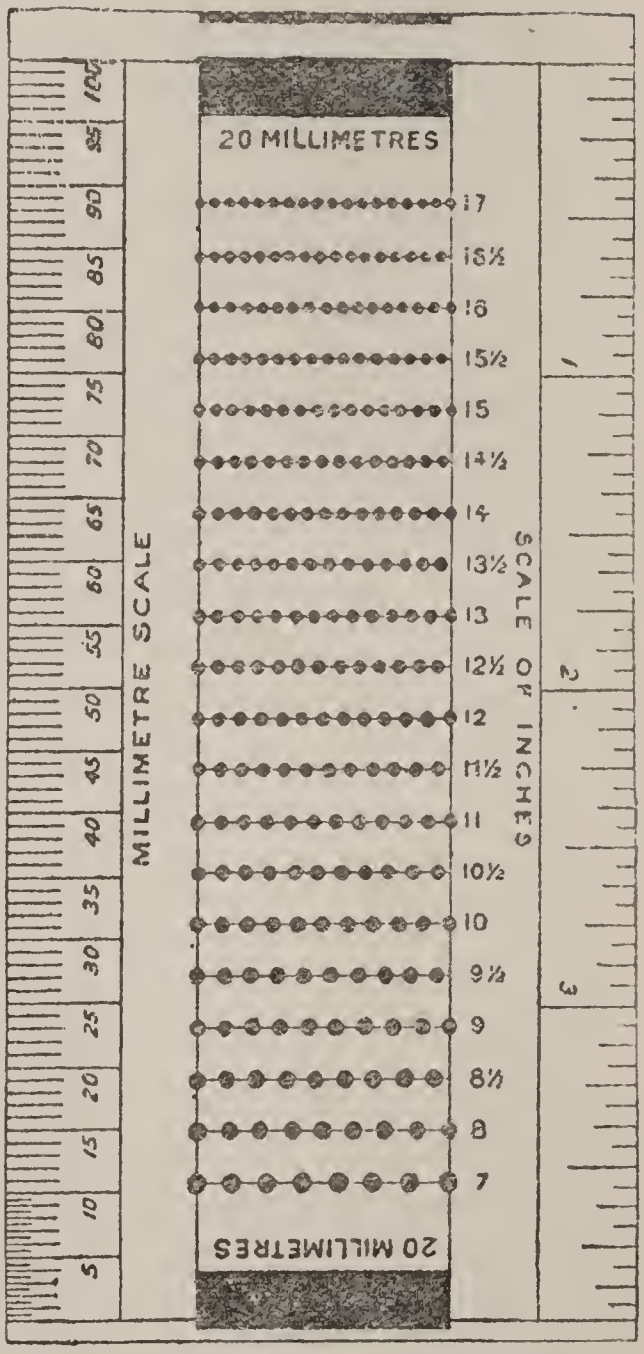


Fig. 9.—Perforation Gauge

Perforations are gauged by the number that occurs in the space of two centimetres (about $\frac{4}{5}$ of an inch). The actual measuring is done by means of a perforation gauge, of which I give a reproduction

(Fig. 9). To measure a stamp, the edge is placed along one of the spaces that seem to contain circles that will coincide with the perforations. If it does not the stamp should be moved along until the teeth exactly fit. The number of the space in which this occurs is the gauge of the perforation of the stamp. With a little practice stamps can be measured with great rapidity, and the commoner perforations, i.e. 10 to 14, can almost be recognized at sight.

In looking through even the most simplified of stamp catalogues the beginner will be struck by the importance of the various kinds of paper and watermark. The watermark is a local thinning in the texture of the paper, which is impressed in it while it is in the pulp stage. It is, of course, a safeguard against forgery. Many watermarks can be seen by holding the stamps to the light, but a much better way is to place them face downwards on a dark surface. In certain cases, notably the issues of our Australian Colonies, the watermark is very indistinct. The best method of dealing with these refractory specimens is to soak them in benzene and lay them on a smooth piece of dark-coloured American cloth.

Many of the stamps of our Crown Colonies were watermarked with the device shown in Fig. 10 (Crown Colony). In 1882 this was changed to Fig. 11 (Crown Agents), and is the well-known "Crown C A" watermark. This, again, was changed in 1904, without the slightest warning, to Fig. 12, the well-known "Multiple Crown C A" now in use. The result of this change was that the dealers were "caught short" of "Single C A" stamps, which immediately soared up to tremendous prices. Many

of our own Colonies had their own distinctive watermarks, most of which are quite interesting. Thus the Cape of Good Hope had the cabled anchor (Fig. 13), and now incorporated into the Union of South Africa it displays the springbok's head (Fig. 14). The old watermark for India was the elephant's head (Fig. 15), which was changed to the five-pointed star. Possibly the queerest of the lot is the watermark of Tonga, one of our South Pacific Possessions,

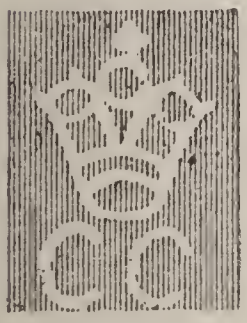


Fig. 10

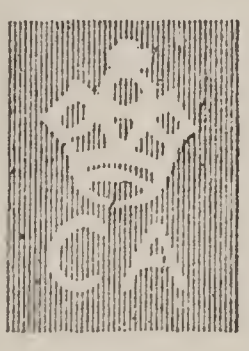


Fig. 11

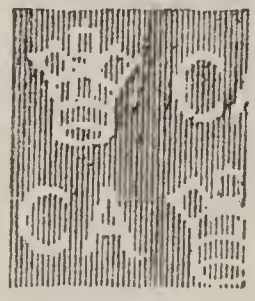


Fig. 12

Fig. 13

in the Friendly Isles. This is shown in Fig. 16, and represents multiple turtles !

The early watermark of the well-known camel stamps of the Sudan was the rosette, but as the similarity of this to the cross was said to offend the religious susceptibilities of some of the Arab sheikhs, it was changed to multiple star and crescent (Fig. 17).

One really great find in the stamp world was made twenty years ago in Louisville, Kentucky. The court house was having its first spring cleaning for many years, and the caretakers were ordered to get rid of a large accumulation of odd documents and papers that had lain undisturbed for nearly half a century. Noticing that some of the papers had

stamps attached, they set these on one side and consulted a jailer, who promised to dispose of them. There was little difficulty in doing so, as the find consisted of the St. Louis stamps of 1845. More than 100 were discovered, and sixteen of these proved to be excedingly rare 20 cent, only two copies of which had been previously known. A pair of these realized £1,026.

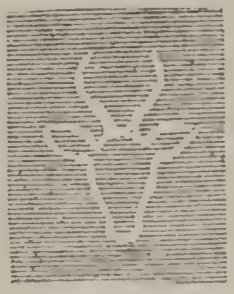


Fig. 14

Of course, there have been many finds of single rare stamps—a 2d. post office Mauritius, discovered in a schoolboy's album, realized £1,200, and now graces the collection of His Majesty the King; a pair of two-cent rose circular British Guiana, dropped into the offertory at Christ Church, Georgetown, by a lady of the

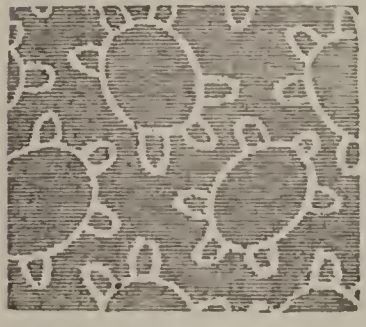


Fig. 16

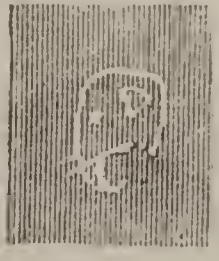


Fig. 15

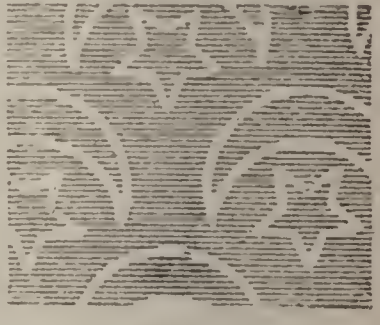


Fig. 17

congregation realized £205 for the funds of the church, and was subsequently sold for £1,000.

Just one word in conclusion. Don't go hunting for finds; they never come that way. Devote yourself to acquiring a good foundation of common stamps in perfect condition, and arrange these neatly and systematically in your album pages.

COLLECTING MEDALS

COLLECTING anything must of necessity be influenced by two considerations: the discovery of the things themselves, and the length of the would-be possessor's purse.

To boys with strictly limited pocket-money medals are almost an impossibility to acquire in anything like quantity, but those of you who are fortunate enough to have generous parents, and, what is perhaps even better, a rich uncle or two, can make quite a respectable collection by way of a start; and few things are more interesting to look at, satisfying to handle, and instructive from every point of view, than a case of medals, especially if they have the ribands attached to them.

Medals may be divided into two distinct classes; those struck to commemorate celebrated people, important events, or some specific act of bravery, and those that are purely military.

It was of the former that Addison wrote: "A cabinet of medals is a body of History. In fact, it was a kind of printing before the art was introduced."

Of those I do not propose to speak here. They are often works of art in themselves, and cost many pounds to buy, while military medals in some cases can be purchased for a very few shillings.

The price is regulated by the rarity of the particular medal and its state and condition. The state may be moderate, good, very good, fine,

very fine, extra fine, mint state, scarce, rare, very rare, and re-engraved. These are terms familiar to collectors and perfectly well known to firms who deal in these things.

The best and almost the only place to pick up cheap medals is, unhappily, the pawnbroker's window. It is a scandalous thing that any old soldier should have to pawn his badges of honourable service, but it is often done, and all pawnbrokers have not an intimate knowledge of their value.

I have frequently seen medals in quite good condition marked up at prices ranging from two to five and six shillings which were worth double that money to the trade.

Of course, the joy of the collector's heart is the possession of a Victoria Cross, the most highly prized decoration in the world. Wealthy collectors tumble over each other when one is advertised, and some curious little romances of the sale-room hang round several of these cherished trophies.

The late Colonel Aitkin, when a lieutenant in the 13th Bengal Native Infantry, won the distinction during the Indian Mutiny, five dates being recorded on the little bronze trinket; but when the day of the presentation arrived the Cross was not to be found, so one was cut out of paper for the ceremony until a duplicate could be prepared.

The Colonel died in 1887, and in 1890 the original Cross mysteriously turned up at Sotheby's, where it was sold for a hundred guineas. It had been in the possession of an officer in the Gurkha Rifles, since deceased, but no one knew how he got it.

Another fine old Crimean artillery man, Sergeant

Cambridge, lost his Cross, and was supplied with a duplicate by the War Office, both duplicate and original appearing in 1897, and passing into the hands of the same collector.

In 1909 the Cross awarded to Bugler Hawthorne, who sounded the advance at the Cashmere Gate of Delhi, realized £108.

The cheapest I have ever heard of was that of Trooper Peter Brown, C.M.R., whose Cross and medals were bought for twenty-five shillings at the Cape and presented to his old regiment; but sixty, seventy, and eighty guineas is no unusual price for these treasured relics, so if you want a Victoria Cross I am afraid you will have to save up for a long time.

Of course, the right and proper resting-place for medals if the dead man has no sons to value them is the recipient's old corps, but if you are bent on collecting, keep your eye on the junk shops and pawnbrokers in your vicinity, write to dealers for their catalogues, and take the *Exchange and Mart*. Messrs. A. H. Baldwin, of Charing Cross, publish an excellent list, and Messrs. Glendining of Argyle Street, have frequent auction sales of both medals and coins, and you can learn a great deal from their catalogues.

A good plan is to try to get a medal for each of our campaigns, beginning with Waterloo. A Waterloo medal can be had for 10s., a South African of the Warwicks for 3s. 6d.

Some collectors specialize in certain directions.

The famous Gaskell Collection, unhappily now dispersed, contained a specimen from every British and Hanoverian regiment present at Waterloo, but

there has been such a rush for military medals of late years that this would be very difficult to do again.

The first British medal for service in the field was a silver badge issued by Charles I in 1643, to be worn on the breast by every man who had distinguished himself in the forlorn hope.

The first issued to officers and men alike for a particular action was Cromwell's Dunbar medal made in two sizes, examples of both being in the British Museum.

Waterloo was the next general medal, but the veterans of the Peninsular War had to wait until 1848–9, when, through the instrumentality of their old comrade in arms, the fifth Duke of Richmond, they received a belated distinction known as the Military General Service Medal, covering actions from 1793 to 1814. Many had died in the meantime, unrecognized and unrewarded, and there were only 20,369 survivors of all ranks left to receive it.

The years had been so long that one old officer had to consult the records at the War Office before he could be quite certain that he had been present at one of the battles for which a clasp was granted.

These Peninsular medals are not difficult to obtain, but vary in price according to circumstances, and the other conditions mentioned above; e.g. one with three clasps, of the Royal Scots, Vittoria, Nivelle, Nive, is catalogued at £2 5s., another, of "The Buffs," very fine with very rare single clasp, "Pyrenees," £8.

Among particular treasures eagerly sought after by the medal hunter are two special regimental

groups both issued in 1794; i.e. one of the twelve gold medals given by the Pope to officers of the 12th Light Dragoons, of whose presentation an interesting picture is in the South Kensington Museum, and the eight gold medals specially struck by the Emperor of Germany for the officers of the 15th Light Dragoons who charged at Villers-en-Couché.

In 1798 the recipients were allowed to wear them, and a ninth was deposited in the Imperial cabinet at Vienna.

Medals sometimes turn up in very odd places. I know of a doctor who bought an oil painting of Napoleon at an old bookshop near Holborn.

When he reached home he found a curious lump at the back of the canvas. The picture had been relined, and the original owner, obviously a soldier of the Emperor's, had placed his Cross of the Legion of Honour between the two canvases, where it had remained all those years.

Revolutionary and Napoleonic medals are not difficult to discover, and I have an interesting group of them. One, however, is extremely rare: the medal struck by Napoleon to commemorate the invasion of England, which never came off. I have seen a specimen in the museum at Boulogne.

The German *Lusitania* medal is a curious example of kultur, so called, and might very well be termed the "Murder Medal."

If you get the opportunity of comparing modern medals with those of our forefathers you will see at once that we have degenerated in the art. Thomas Simon, who designed during Cromwell's time, was a much greater artist than almost all his successors,

and some of those worn to-day are mean and cheap to a degree.

Among the most celebrated collections of recent times were the Gaskell, Harris, Tancred, Whitaker, and Lord Cheylesmore's, the last of which you may see, happily still intact, in the museum of the Royal United Service Institution.

When the Naval General Service Medal was given at the same time as the Peninsular it was, of course, retrospective, and covered 202 actions. Captain Whitaker possessed more than a hundred varieties, and a gold Boulton Trafalgar Medal sold for £22.

COINS AND CRESTS

COINS are more easy to accumulate than medals, and a very decent collection can be made at quite a small expenditure, or by the favourite method of "swapping."

Of course, if you yearn after early specimens they are going to cost you much more than their proverbial weight in gold, as witness a British gold stater of Epaticcus, which realized £42 at the Dawnay sale in May, 1922. In the same rooms, Sotheby's, a silver penny of Stephen's reign brought £40, and a five-guinea pattern piece of George III sold for £70; but the young collector has a wide and much less expensive field in which to wander, and my advice is to begin with copper.

The original pennies, introduced by King Offa in 735, were of silver, and our terms, halfpenny and farthing, were first applied to one of these silver coins cut into two or four pieces. Edward I was the first British monarch to coin them separately, but it was not until Charles II's reign, 1672, that copper farthings and halfpence were introduced and made current for all payments under the value of sixpence. Copper pence were not struck until 1797, and since 1860 bronze has been the metal used.

Trays of copper coins are to be seen in nearly every junk shop and dealer's window, and hoards of them are constantly turning up in most unexpected places. I found a Charles II halfpenny myself in a crevice of Gorleston pier, and a friend of mine has a box full

of copper coinage that was fished out of the River Dove, in Derbyshire, some of it very rare. Workers in the fields at Sandy, in Bedfordshire, once a Roman station, constantly rake up coins, and I have five that were discovered in this way.

But perhaps the most curious finds of late are those recently made by a Kentish butcher who discovered a Charles II farthing dated 1674, a George III halfpenny, 1806, and numerous other specimens in the stomachs of bullocks he killed. The animals had been grazed on the Sheppey marshes, and must have come across some hidden hoard.

King Offa's Penny

Commence your collection by trying to get a copper coin of each reign from Charles II, exchanging faulty examples for better ones as occasion offers, and then work up through sixpences and shillings to the handsomest coin of all, the crown piece.

The present value of these varies. For example, a Charles II is roughly worth about 7s. 6d., James II 9s. to 10s., William and Mary 15s., and William III 7s. 6d.

You have all seen those blocked-up windows painted in feeble imitation of the real thing in old houses, and it is interesting to remember that the window tax owed its origin to the scandalous debasing of coin of the realm in the reign of William III. It became so bad in 1694 that it was called in to be re-coined.

I know of a crown piece of William in splendid

preservation that had slipped behind a farmhouse window and lain there for 119 years before it was found. It must have been a serious loss to its owner when one remembers that money was worth about five times its subsequent value at that period.

Charles II Halfpenny

A Queen Anne five-shilling piece is worth about 12s. 6d., as is also a George II, while for a good specimen of George I one can get anything from 25s. to 30s. Those of the remaining reigns up to the end of Victoria are practically worth 7s. 6d., but everything depends, of course, on their condition.

Remember there were no five-shilling pieces struck in 1804; if you find one with that date it is a forgery. But Spanish dollars of 1795 were stamped with a tiny head of George III, and issued as crowns in 1804, their present value being 10s.

Tampering with money or dealing in false coin was such a serious offence in olden times that in Edward I's reign anyone bringing pollards or crockards (foreign coin of base metal) into the country was liable to forfeiture of life and goods. In Edward III's reign it was made high treason to counterfeit coin of the realm, and under Henry V to make coin, or to bring into the realm any gally halfpence, suskins, or dotkins, was to be guilty of felony. To attempt to pass them meant a fine of a hundred shillings, while clipping, washing, rounding, or filing money under Elizabeth was again made high treason, and high treason meant death!

One of the best mediums for securing coins is through the *Exchange and Mart*, which has always been an excellent collectors' journal.

Coin collecting is sometimes attended by considerable risk. A high official at the British Museum told me a strange story thirty years ago.

They had in the museum the only known example of a tiny Greek coin. I forget its exact name, but it was about the size of a threepenny piece, and scarcely thicker than a visiting-card.

One day a clergyman asked to examine it, and at that time they were less careful than they are now, but they were going to learn a lesson.

The coin was produced, the reverend gentleman brought out his magnifying glass, and was left with the precious unique little bit of metal for a considerable time.

When the moment came for him to return it to the custodian it was nowhere to be found. "He searched, they searched, and rummaged everywhere," as Byron puts it, but it had gone!

When he was informed that it would be necessary to search him he waxed so furiously indignant and betrayed such agitation that the police were called in and the door of the gallery locked.

Again and again he protested his innocence, and everybody went down on hands and knees for a final hunt, when one of the attendants felt something sticking out from a nick in the floorboards, and drew out the missing treasure.

Spanish Doubloon

"Now, gentlemen," said the clergyman, "I will tell you why I objected to being searched, and you will understand," and opening his pocket-book he showed them another unknown example of the hitherto unique coin!

Had they found it upon him he would certainly have gone to prison, for the two were identical, and their own specimen might be lying to this day where it had fallen.

Since then the greatest precautions have been taken, and no one is allowed to handle any of the rare specimens without close supervision. It is far too dangerous a thing for all concerned.

I believe I am right in saying that a third example of that coin is now known to collectors.

Thousands of coins have been found in the Thames, great quantities of them during the rebuilding of old London Bridge, and a Deptford gentleman collected 600 coins from the gravel that had been used to repair a pathway.

An old gardener of mine once discovered a gold coin of the Emperor Hadrian, which is now in the British Museum, during the construction of a reservoir near Tottenham.

The guinea dates from Charles II, when it was first made from gold sent home by the Guinea Company, and named after them. Little Samuel Pepys in his diary gives us the actual date of their issue, 21st September, 1668—"This day came out first the new five-pieces in gold, coined by the Guiny Company; and I did get two pieces of Mr. Holder."

In the third year of George I the guinea received

its recognized value of 21s., and the last issued were in 1813.

Spade guineas may be purchased at prices varying from £1 7s. 6d. to £2 10s., but during the present year a James II two-guinea piece, 1687, fetched £13, a Queen Anne five-guinea piece £1, and a George III pattern five-guinea piece, dated 1777, £70.

The ancient method of coining was to cut and shape each piece of metal, place it between two dies, and strike them with a hammer. It was a very primitive way of doing things, the difficulty being to keep the metal in position so that one die came exactly over the other.

A great improvement was made in 1623 by Briot, a French artist, who had invented a press and was appointed chief engraver to our Mint, and though the hammer was occasionally reverted to, by 1662 the mill and screw were permanently adopted.

Monsieur Briot must have had his work cut out, for among the coinage of Charles I there were in gold the carolus, double crown, angel, three-pound piece, twenty-shilling and ten-shilling pieces, rose and spur rials; and in silver the twenty- and ten-shilling, seventeen different dies of crown, half-crowns, and of siege pieces the crown, the three shilling, two shilling, eighteenpenny, fourteen and thirteenpenny pieces, shillings, pennies, groats,* which were fourpenny bits, threepenny and twopenny, pieces. Siege pieces were, as the name implies, hastily coined for immediate necessities, often in

* The groat whose value was fourpence was first issued by Edward Longshanks and revived again by William IV, when they were nicknamed "Joeys." The last were struck in 1856.

some beleaguered town or castle, and consequently very rude in execution.

If you set your imagination to work as you examine your coin cabinet and those of your friends, it is like reviving history in a very tangible form. That five-shilling piece may have been tossed in payment for a cup of wine by Prince Rupert himself when he drew rein some dusty day at the door of a roadside inn; this carolus very possibly changed hands on Hounslow Heath through the persuasive menace of Claude Duval's pistol!

In the old days men going on a journey had to carry their money with them, and it was only when bankers' drafts were instituted at the end of the eighteenth century and saddlebags no longer bulged with coin of the realm that the craft of the gentle highwayman ceased automatically for all practical purposes.

A very interesting collection may be made of French copper coinage from the Revolution onwards, and one can identify from the mint mark the exact town in which the coin was struck. There were twenty official French mints in those days, and they turned out some very handsome pieces.

Foreign money is interesting and quite easy to obtain. Those of you who have travelled on the Continent must have been struck with the different nations represented in a handful of loose silver.

I remember once returning from Belgium with three five-franc pieces, all the money I had left. One was a Napoleon I, a remarkably fine specimen which I wished to preserve; another was a Louis XVIII, and the third a Roumanian. I intended to

change two of them on the boat and keep the Napoleon, but when I offered the steward the Louis XVIII he proclaimed it out of circulation. The Roumanian proved to be a bad one, and there was nothing for it but to part with Napoleon's portrait.

I was coming back from the Field of Waterloo, which battle Napoleon lost. I lost my five-franc piece, and oddly enough it was dated 1815 !

The big penny of George III is quite easy to procure for three or four pence ; they must have been terrible things to have carried in one's fob, and that reminds me of a little aneedote, for which I can vouch.

The father of Hutton, the celebrated bone-setter, purchased a racehorse from a friend of my father's for £300. The old man was an eccentric, and when it came to settling up he arrived with his man carrying a heavy sack on his shoulder, containing the amount in sixpences, which he insisted on the seller counting out under his nose. Of course, it was not a legal tender, but it was take it that way or leave it, and the vendor took it !

One would like to chat about such things as Spanish doubloons and pieces of eight. Snap them up when you can get them, and again let your imagination carry you back to the days of the buccaneers.

Queen Anne farthings and Wood's ha'pence are things to look out for, and Irish money is bound to become valuable as time goes on.

Remember there were no Irish pennies of George II, and no George III pennies of 1773.

Some boys colleet Chinese "cash," which has

a square hole in the centre of it and is carried threaded on a string, and our Indian currency is easily obtained.

Some coins have a tragic history. When the gallant defenders of the Delhi Magazine were making their escape after they had blown it up, one of them, Lieutenant Willoughby, with a handful of fugitives and an empty carbine, was held up by a swash-buckling rebel, who demanded their weapons. In a last attempt to get away Willoughby loaded the carbine with a copper Mussoree *pice* and shot the fellow through the chest. Unhappily his shrieks brought out the inhabitants of five neighbouring villages, and the little party were all butchered.

Many books are published on the subject, of course, but the best of all are the catalogues issued by the British Museum authorities.

It is a fascinating hobby, but I am afraid you will find, as I have done, that while the ancient specimens are the most difficult to obtain, the modern coins are even more difficult to keep!

An album full of crests is a very nice thing to possess. Some of them are quaint and curious, others very beautiful, and all tell a story.

The word is derived from the Latin *crista*, the comb or tuft which grows upon the heads of many birds.

Their original use, as worn on the helmets of military commanders, is quite obvious—a kind of personal trade-mark and a rallying point for the soldiery.

Crests are older than heraldry, though they subsequently formed an important part of that science; yet some families whose coat-armour is of

the most respectable antiquity have no crests at all.

There is actually a difference between a crest and a badge, although in some cases they are used interchangeably.

Crests were common in Chaucer's time, but Edward III was the first monarch to introduce one into his great seal. To-day they are generally used on the family silver and notepaper, a guinea having to be paid to the excise for the privilege.

For the purposes of collecting they can be divided into various classes, such as family crests, regimental crests, battleships, and those used by public bodies.

You can buy the regimental ones in packets for a few pence. Messrs. Gale and Polden issue a fine series of these ; but by far the most interesting way is to get them from friends in the various regiments. Ask them to send you the regimental Christmas card, which generally has the crest in gold and colours upon it. By this means you get the personal touch.

Family crests are a little more difficult to obtain, and some of them are quite expensive. Many appear on book-plates, and although I deprecate the custom of removing these from the volumes, it is one way of getting them.

As most of them have a motto attached—and Washbourne's " Book of Family Crests " on my table contains nearly four thousand examples—it is astonishing what a great deal of Latin the collector may learn if he will take the trouble to translate the mottoes. This in itself is ample justification for collecting crests, apart from the pleasure your friends will derive as they examine your specimens.

VARIOUS COLLECTIONS

I.—BAXTER PRINTS

IF you want to have a unique collection, or at any rate one which only about two per cent. of your friends have ever heard of, start collecting Baxter prints. A number of these are exceedingly expensive, but there are hundreds of cheap ones, which can be picked up for next to nothing provided that one does not mind doing a bit of hunting.

Baxter prints are sold either loose or in the books in which they were originally issued. The present writer constantly comes across them in the course of his book hunting up and down England, and in many cases he has been offered books containing rare Baxter prints for 6d. or 1s. each. You probably may not be interested in the books themselves, but the Baxter prints are as a rule quite easily removed, and can be lightly pasted into an album.

There are an enormous number of forgeries of Baxter prints, but you must not be taken in by them. The genuine ones have at the foot of them, "Printed by G. Baxter, London," and are exceedingly well executed and perfectly finished. If you come across Baxter prints that are damp-marked, spotted, or "foxed," as it is termed, give these a miss, as they are generally useless.

An advertisement in papers like *The Publisher's Circular* and *The Print Collector's Quarterly* from time to time will bring you quite a number of offers of genuine Baxter prints. There are several

societies that make a speciality of them—for instance, the Drood Society, in London. You can collect Baxter prints at any place you may happen to be. For instance, if you spend a seaside holiday at any time, you will probably find a print dealer in some by-street who is open almost to give away prints if he is tackled the right way. Visit these print dealers in your oldest clothes, and on no account put on the manner of a man about town, or a man of means; otherwise prices may be fifty to five hundred per cent. higher than you would otherwise be asked.

II.—SOME INTERESTING SLAGS

Slags, as many fellows know, are waste materials which form above the metal itself during the process of smelting. A representative selection is not difficult to get, and it need cost the owner nothing at all except a few pence perhaps in the matter of postage.

First of all there are blast furnace slags, of which there are several kinds, hard and glassy, soft and powdery, and medium. Good samples of these can be picked up in hundreds outside any ironworks, and while we are collecting them it would be a good plan to get a sample of what is known as slag cement or concrete, which is wet flour slag after it has been beaten hard, and dry floury slag after it has been slaked in the air.

After this we must add to our collection basic slag, in lump and powder form, and Siemens' slag. These are produced by the basic process and the Siemens process in steel-making respectively. We

Indian Stamp, with Head of Local Ruler

A Sea Stamp from Toga

Dragon Stamp, a feature of China and Shanghai

An Industrial Stamp from Newfoundland

Another Industrial Stamp from Newfoundland

Spanish Stamp, showing Don Quixote tilting at the Windmill

Australian Stamp, showing view of Sydney

1922 Hungarian Bolshevik Issue

Chilian Stamp, with head of Christopher Columbus

SOME INTERESTING STAMPS

Facing page 40.

Cross of the Legion of Honour

Indian Mutiny

Talavera

SOME HISTORIC MEDALS

Facing page 41.

can still further increase our collection by adding fused lime-stone slag from lime kilns, as well as the slag from lead-smelting and copper-smelting works in Derbyshire, South Wales and Cornwall. A few other slags may be added if desired, but these are of minor importance.

All slags should be classified under the industries producing them. Small hand specimens of the harder forms, and large pill or tabloid boxes of the powdery forms, can be accommodated in shallow drawers of the type used for minerals and fossils. Each slag should be carefully labelled with its name, approximate composition, and locality, i.e. works producing it, so that if anything unusual is noticed about it at a later date a further supply can be obtained without much difficulty.

III.—RAILWAY STAMPS

To start a collection of railway stamps, get all your friends to reserve what they receive on parcels coming by rail, and, of course, watch most carefully any parcels which you receive yourself from the various railway companies. Very often you will find that a single parcel has several stamps on it, and if the square of paper on which they are stuck is carefully cut out of the rest of the paper these stamps can generally be removed without difficulty by soaking them.

It is quite worth while to buy unused railway stamps occasionally, especially if your collection is nearing completion as regards any particular company. This can be done from your local station as

a rule, or through the parcels offices of the bigger stations.

It is a great mistake to start a book of these stamps at too early a date. Keep them in extra large envelopes, on the outside of which you have written the name of the company, and then, when your collection is nearly completed, you can set about mounting them in a book in much the same way as you would mount postage stamps.

Section II.—OUTDOOR HOBBIES

WOODCRAFT AS A HOBBY

THOSE of us who have an inborn love of adventure and the open air will find the study of woodcraft of most absorbing and romantic interest. To some, of course, a wood is simply a collection of trees and shrubs, all more or less alike, and beyond these there is "nothing particular." Such people have two eyes, it is certain, but it is a question if they do not think one of them superfluous. Nothing short of an elephant or a lightning flash will attract their attention, and their ears are insensible to sounds less overpowering than a clarion call. The flowers are all buttercups, the plants all grass, the birds all sparrows, the clouds all black.

To advise boys with such dormant faculties as these to undertake woodcraft as a hobby is somewhat akin to trying to roll a gravel path with a reel of cotton. But, fortunately, in these days when the call of the countryside is so insistent, this type of boy is rare, and the call of the open air awakes in most of us an answering call when our eyes are opened to the glories of the wonderful world in which we live.

I am afraid, too, that there are some people who take the study of woodcraft too seriously. They set out to "do" so much each day, something after the manner of the American tourist who rushes from city to city and plans his trip simply to a time-

table. At the end of the week he looks through his diary and feels perfectly content if he has "done" all the places he set out to do; he derives little enjoyment in the things he sees, and probably he remembers little of them; his self-satisfaction consists in being able to tell his friends that he has visited a large number of famous places.

The keynote of any hobby must be simplicity, and this applies especially to the study of woodcraft. In our everyday work I know that it is quite necessary that we keep to a time-table, so that nothing is overlooked and the time at our disposal is duly apportioned, having strict regard to the importance of the work. Every one of us became quite used to working to time-table when we were at school, and, of course, school-life could not be carried on successfully unless we did work in this manner. But it would be a great mistake to cultivate any hobby where all our actions are more or less mechanical, for it is quite essential that we be enthusiastic and interested in the pursuit of our hobby, and not think of it at all as work.

I think the following little incident will make my meaning quite clear. Two Boy Scouts whom I knew quite well had decided to work for their Stalker's Badge. They were town-bred boys and knew very little of wild life and the countryside, but they spent a holiday with a farmer who had the shooting-rights over a large wood, so that they were at liberty to go into the wood as often as they pleased. The lads had a fortnight at their disposal, and on the first day they drew up a time-table of the work they proposed to do on each of the twelve days,

omitting the two Sundays. I saw this time-table and it ran something like this: Monday—a ramble all over the wood with a compass; Tuesday—bird-nesting; Wednesday—a study of trees; Thursday—stalking; Friday—tracking; Saturday—a study of woodland plants; Monday—a day's rabbiting; Tuesday—a search for a fox's earth and a study of any other wild animals; Wednesday—a study of woodland plants; Thursday—a study of Indian signs; Friday—snapping any birds or wild creatures with their Brownies; Saturday—a collection of cones, leaves, twigs and bark, together with specimens of ferns and mosses.

Now when these boys returned home they were not at all enthusiastic in the subject of woodcraft; their great aim had been to obtain the Stalker's Badge which was duly awarded them by their Scoutmaster. They had entirely missed the make-believe of the thing, which is half the fascination of woodcraft, and it is certain that they would never take it up as a hobby. They had killed any enthusiasm they might have cultivated by making themselves machines, so to speak; they had been searching for things they could not see, all the while blinding themselves to those which were at their feet. Never once did they revel in creeping and crawling through the undergrowth in order to watch at close quarters the gambolling of some squirrel around the bole of a tree, and it would have been much too uncomfortable to lie flat on their stomachs and worm their way through long grass so that they could have studied at first hand the lives and habits of many of the woodland creatures about which they had read in

books on natural history. I am afraid these boys would much prefer to get their knowledge of wild life from cinemas, for it is certain that they had entirely missed the meaning of Nature's wonderful ways which were everywhere in evidence in the green fields and shady woods had they only possessed the true spirit of the genuine woodcrafter.

I often think when reading Shakespeare that the great poet must have learned much about woodcraft in the wide woodlands around his delightful home at Stratford-on-Avon. All through his works there is abundant evidence that he had surprised many of Mother Nature's thousand and one secrets and, as he so aptly expressed it, he could find :

> tongues in trees,
> Books in running brooks, sermons in stones,
> And good in everything.

But we shall have to " cut the cackle and get to the 'osses." The very best way to study woodcraft and become familiar with all the tricks and wiles of the woodcrafter is to make a friend of the gamekeeper. You would probably learn more of the art in a month of his company than in a year by yourself. Furthermore, most woods where game is preserved are quite private property, and trespassers are prosecuted, so there would be little chance of rambling along the tortuous ridings unless one had permission from the gamekeeper.

It was my good fortune when a boy to come almost into daily contact with a gamekeeper, for he and my father were firm friends, and much of my knowledge of woodcraft was obtained in his company during

our numerous walks through and around some large woods in Suffolk. He was usually known to the village boys as "Old Velveteens," probably because of the reddish-brown velveteen jacket which he wore. He has long since died, but I still have a vivid picture in my mind of his ruddy and weather-beaten face surmounted by a Homburg hat with a pheasant's feather set jauntily in the side. The puckered skin beneath the eyes was striking evidence of the long vigils in the silent night-watches, when young partridges and pheasants had to be protected from human as well as four-legged poachers. Many a time have I seen a lusty leveret or a nimble rabbit slipped into one of the capacious side-pockets inside his jacket.

The old proverb, "An ounce of wisdom is worth a ton of theory," is never more in evidence than in a few days' companionship with a gamekeeper. He will know every bird by its call note; he is able to distinguish animals by their tracks alone; he possesses the Red Indian's uncanny instinct in hunting; and often he will call to the wild birds and hear them answering to his call. In his leisure hours he takes out a camera and snaps wild birds in a manner which would do credit to some of our great naturalists. He knows the runs, drinking-places and burrows of most of the woodland creatures, and reynard's underground home, cunningly though it is contrived, is an open secret to him. There are few people, however indifferent they may have been to the call of the wild, who would not become fascinated with woodcraft when the secrets of the woodlands are laid bare by Old Velveteens.

One of the most interesting studies in woodcraft lies in the art of identifying the tracks of animals. Each animal has its characteristic track, and it will have to be taken or sketched for future reference. Usually you will get only the imprint of four of the animal's toes, unless it has sunk into moist ground, when all five may be seen.

Of course tracks are identified best when snow lies on the ground, especially when the snow is frozen so that the animal does not sink in and obliterate its footfalls. At other times the best places to study tracks are on the sandy banks of watercourses, or the muddy soil in the damp corners of the woods. If one is setting out to make a special study of trails he should go after rain has fallen.

There are several ways in which tracks may be taken and preserved without incurring great expense or trouble in the preparation. Of course, the simplest and most inexpensive way is to sketch them, but we need an exact reproduction of the track itself which can be permanently preserved. All that we require are some wax, a box of matches, a small tin with a wire handle, and a pocket-knife. If there is any difficulty in getting wax, candle-grease will make an excellent substitute.

As soon as a clear impression is found of the animal's footfall we build up a small ridge of clay around it, care being taken not to allow any of the clay to fall on the track. Then light a small fire with a few dried sticks and set over it the tin with a lump of wax placed inside. This will soon become liquid, and then very carefully pour the molten wax into the track and wait until it becomes solid. Next

remove the surrounding ridge with the knife, and insert the blade under the waxen mould and gently raise it. Place it in a box and when you return home mix into a paste some plaster of paris and a little water in a flat tin. When the paste is nearly set, and resembles putty, press the wax mould into it and leave it to set hard. To remove the wax it will have to be heated until it begins to soften, then it can be gently lifted and gradually removed. This requires great care, but a little practice will soon make one quite proficient.

The most common tracks which are taken are those of the hare, rat, rabbit, fox and hedgehog. It is very difficult to obtain those of the badger, squirrel and otter. I have seen an otter's tracks several times when on angling expeditions, and I knew quite well that they were an otter's tracks because I saw the animal make them, but they were very indistinct. Probably this is partly due to the curious habit of otters always following in each other's footsteps, and their landing places are marked by innumerable blurred trails.

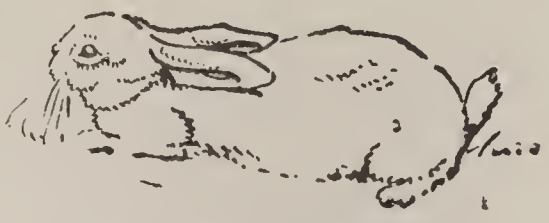
The track of the rat is easily distinguishable. Its five tapering toes somewhat resemble the human hand, and if one expressed the character of animals by their footfalls he would be inclined to give this creature a loathsome reputation. The hedgehog leaves behind a curiously shaped footfall which is comparatively broad with pincer-like toes.

Hedgehog

Gamekeepers learn to follow animals long distances by their trails, and frequently they are

able to tell at a glance the class of animal which has robbed a hen-roost in the night. Some years ago when weasels and stoats were rather common in the woodlands, their depredations were even more terrible among fowls and game-birds than those of the fox, but as these creatures have become nearly exterminated most fowl-house robberies are made by reynard.

The very best way to discover animals in the woods is to stand quite still; indeed, if you "freeze stiff" you may often find a rabbit, hare, fox, or game-bird come to within a few feet of you. There is, too, a distinct art in stalking animals and birds. Long practice will enable you to preserve your balance so that you can move absolutely silently. Have you ever tried a game called "steps?" It used to be rather common in school playgrounds when I was a boy. One boy stands close to a wall which he faces, and the other boys try to reach him without being seen or heard to move. The boy is at liberty to turn round as sharply as he can, and if he detects another boy moving, the latter is at once sent back to the starting point. Step by step the boys lift their right legs very slowly off the ground until their knees are well bent, then they slowly straighten their knees, after which their feet are lowered so that the whole of the foot, toe and heel, touches the ground at the same time. Gradually the weight of the body is transferred to that foot and a similar process is gone through with the other one. It all sounds very easy, but try it; you will probably find it difficult to preserve your balance, especially if you try to make quick progress.



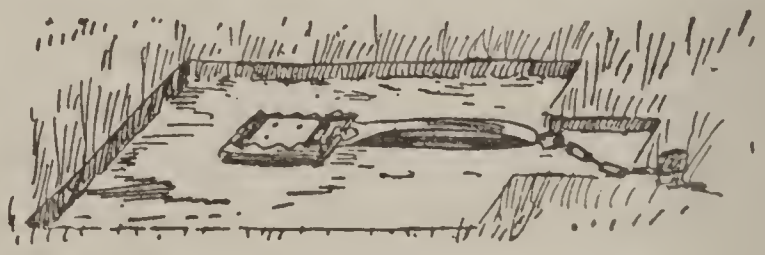
Brown Hare Sitting Tight

Most animals which live in woods make their homes along the outside of them. This is due to the fact that they can get more light and air on the outskirts. Rabbit warrens usually skirt cornfields, and in the days when weasels and stoats were common, one was almost sure to find these natural enemies of the rabbit living very adjacent. Some years ago word went forth to the gamekeepers to exterminate the weasel group, which embraces the polecat, stoat or ermine, and, of course, the weasel itself. The order was taken up very energetically, because this group had long been looked upon as a pest owing to its depredations among game-birds and their eggs, and I remember seeing twelve of these creatures dangling from the keeper's tree at one time. In time it became extremely difficult to find a weasel, and all was thought to be well, but there is another side to the story, which all woodcrafters will do well to ponder over.

You have heard of the Balance of Nature, and when man deliberately upsets this fine balance, he most assuredly suffers for it. The weasel family preyed largely upon rats, and probably more of these vermin were destroyed by these animals than by traps, dogs, or other contrivances. Since the stoat and weasel have been practically exterminated we have suffered three or four disastrous rat plagues, notably in the east of England around the estuaries of the Orwell and Stour. Experts who went very fully into the subject estimated that there were over

forty million rats in England, and that each rat costs nearly a farthing a day when account is taken of the damage it does and the food it eats. Moreover, rats multiply exceedingly fast. On an average each litter of young rats contains thirteen, and there are eight litters a year. When we consider that a rat has her first litter when she is about three months old, and that she lives for several years, we can well understand the enormous number there would be if there was not some natural check on them.

Everyone who undertakes woodcraft as a hobby will have to learn a few of the tricks of trapping, and

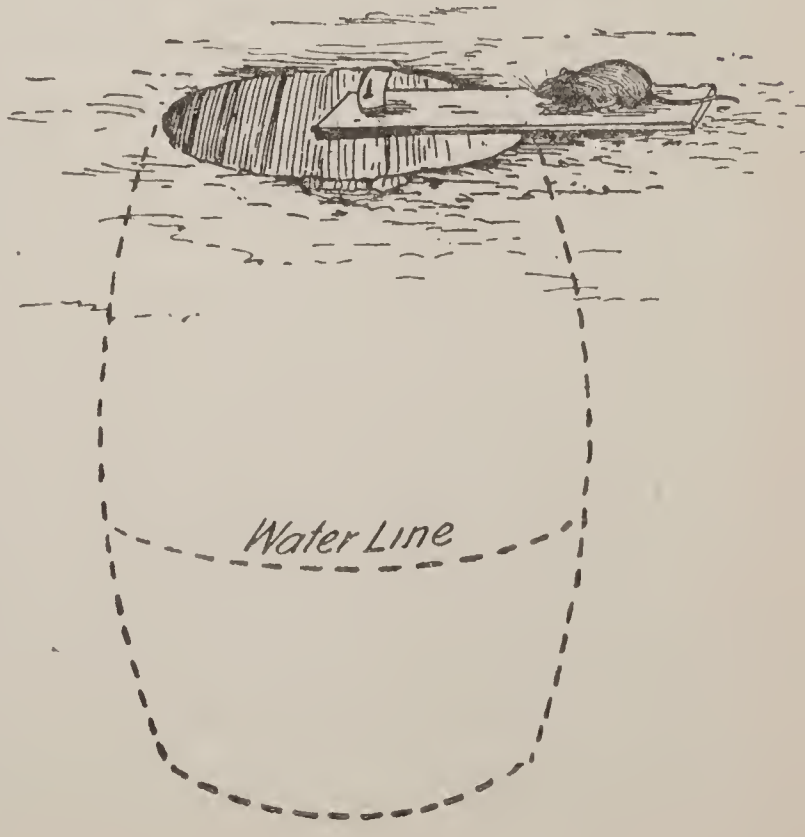


sometimes boys can make this pastime quite remunerative, for farmers usually pay "twopence a tail" for all the rats you can bring them. During the war, and immediately after it, a high price was realized for moles, and a young country friend of mine tells me he was paid a shilling for each mole he took to the dealer. Now that the price of fur has fallen the rate is much less.

The most common contrivance for catching rats is the steel trap, but if you are to be very successful you must be up to all manner of ruses. For example, a rat's trail was traced to my friend the gamekeeper's fowl-house, and the rat was known to enter through a hole about a foot from the ground. A steel trap, with vicious-looking jaws, was set on the ground

immediately below the hole and covered lightly with mould. The creature skilfully avoided it the next night, but there was evidence that it had visited the fowls by the usual entrance. The following day the keeper procured a piece of fresh meat which he nailed a few inches to the right of the hole, and beneath which he set his trap, artfully concealed. The bait proved too much for the rat to resist; for in the morning he was found caught just above his hindquarters, as though he had sat down in the trap. Always be careful to stake down the trap. for rats have enormous strength for their size, and will sometimes drag the trap to considerable distances.

If it is desired to catch the rat so that it is not killed, a wire trap is preferable, but these highly suspicious creatures need to be enticed very cunningly before they will enter. Some gamekeepers employ one or other forms of the dead-fall trap. One type which I have seen in use consists of a heavy plank of wood raised from the ground at one end by two small wooden supports about two inches long and half an inch in diameter. Between these two supports the bait is inserted. This may



consist of a small bone on which a little meat has been left. The rat on finding the bait, tries to remove it, when the supports collapse and the plank falls on its body.

When I was a boy I tried the water-barrel trap, but seldom had any success with it; however, a description is given for what it is worth. An ordinary barrel is procured and this is partly filled with water, say, about a foot in depth. In the centre of the pool a bar of iron, or one brick laid upon another, is placed so that it stands about two inches above the surface of the water. A lath is hinged to the edge of the barrel, so that one end of the lath rests on a shelf or ledge along which the rats are wont to run, and the opposite end overhangs the centre of the barrel. At this end the bait is fixed. If all goes well the rat scents the bait and warily walks along the lath. As soon as he has got to the other end of the see-saw his weight presses down the lath and he is shot into the water below, when the lath immediately returns to its former position. He cannot climb up the slippery surface of the barrel, and it is too far for him to jump out, so he swims around until he takes anchorage on the iron bar. He at once begins to make a curious squeal, and probably other rats which may be in the vicinity come to his help and suffer the same fate.

I have heard of cases where more than a dozen rats have been caught in a single night by this form of trap, but I have never succeeded in catching more than one. However, the trap is inexpensive, and as it gives little trouble in setting it is worth experiment.

There is much fascination in trapping, although I am afraid the desire for this sport arises from the baser primeval passions of man—to kill. A side of woodcraft which appeals with even more force is that of ferreting for rabbits. The first thing one has to do is to select suitable burrows, which are usually found in a spinney adjoining a wheat-field. A number of nets, somewhat resembling the country housewives' potato-nets, are procured, and these are carefully staked over the numerous bolt-holes. They are allowed to hang loosely so that when the frightened rabbit bolts he runs his head through the mesh of the net, and is caught. Usually the hunter leaves the principal hole in the warren quite open if he has a gun, and he would take up his position a few yards to the rear of this.

When all the holes are properly staked one or more ferrets are guided into them, and they at once set out on the trail of the rabbits within the burrows. Soon one may distinctly hear the frightened rabbits scampering along the "runs," especially if the ear be laid to the ground. In a short time first one and then another bolts, either out of the free hole, or into a net.

A properly trained ferret will not actually attack a rabbit in its burrow, but seeks to drive it before it. On occasion, however, underground squeals may be heard, and there are signs that a terrible duel is being fought out. Usually the rabbit has its "back to the wall" and the ferret bites chunks of fur and flesh from its quarry. In such a case the burrow must be opened above the place whence the sounds come, and when the duellists are laid bare a

sorry sight presents itself. The ferret is torn from its prey and receives a severe trouncing from its master, after which it is consigned to the box and kept on starvation rations for several days.

Trustworthy ferrets are allowed to run into the burrows quite freely, but when the ferreter has reason to believe that the ferret will not emerge when it has finished hunting it is generally placed on a long lead. On one occasion I remember the keeper had to spend more than two hours in digging a wandering ferret out, and ever afterwards this creature was used with a lead.

All woodcrafters will have to learn the most humane and quickest way in killing rabbits and other game. There is quite a knack in killing a lusty rabbit. It is taken up by the hind legs while you take hold of its head with the thumb tightly pressed into the spinal column at the junction of head and neck. Just a quick jerk with the necessary force and the spine is broken so that the animal dies practically a painless death.

There are two animals which all interested in woodcraft must study very closely, viz., the fox and the squirrel. Both are essentially creatures of the woods and spinneys. There is no need to question what animal is prowling along the hollows well under cover when nightfall or dawn is approaching, for every wakeful bird raises the alarm—when reynard slinks home. He is looked upon as their deadly enemy, and probably he is quite the most unpopular creature in the woods if we judge by the actions of his fur and feather neighbours. Hear the old cock-pheasant raising his strident warning when a fox is seen; the

thrushes screeching, the jays chattering, and the smaller fry showing by their notes a lively agitation. None of these birds has any reason to fear him because they can easily fly to safety, but perhaps instinct tells them something of his reputation for robbing their mothers' nests of their eggs and young.

His lair, or "earth," is most ingeniously constructed. Perhaps he has purloined the home of some burrowing animal, such as the badger. His reputation for cunning is shown by the lay-out of the earth. There are numerous tunnels intersecting each other in all directions, and frequently there are from eight to ten bolt-holes. Around the lair there is a most peculiar scent, and when he emerges and flies before the sound of the huntsman's horn, the hounds follow him by this scent.

His cubs are very playful creatures, and he is a devoted parent. Strange to say, foxes often live cheek by jowl with a colony of rabbits, although reynard frequently takes toll of their number. The gamekeeper knows all about the various earths, for it is part of his business to supply foxes for the hunt in the winter-time. Probably, if he had his way the fox would follow the fate of the weasel, for reynard is most unpopular by reason of his game-killing habits. Foxhunting is one of the last "blood" sports left to this country, and in many ways it is a degrading spectacle.

Probably the squirrel is the most popular animal in the woods, if one judges by the attention he gets from human stalkers, all of whom are anxious to come to close quarters with him. His sense of hearing is so extremely well developed that it is

most difficult to approach him when he is on the ground. It is certain that there are no more playful creatures in the woods than a family of young squirrels.

The squirrel makes a great round nest of sticks, which is known as a drey. This is fitted together with roots, grass, twigs and other materials, and is rather a clumsy structure. There is an opening in the side. Other nests are often made as places of refuge, and frequently the old nest of a rook forms the foundation for his drey. His winter quarters are usually in a tree's hollow.

It is interesting to watch a squirrel falling to the ground when he misses his foothold on a tall tree. The body is spread out to the fullest possible extent, and with the long brush forms a kind of parachute which enables the animal to fall comparatively slowly.

The badger is now entirely missing from most parts of England, but one occasionally hears of him making his home on the southern slopes of some isolated wooded knoll. Should you be lucky enough to find his den and open it up, you would see that it was most ingeniously constructed. There are ten or a dozen passages, each about twelve yards long, leading towards a central chamber. This is lined with fur, moss, feathers and dry leaves. Most of the passages serve as bolt-holes in time of need, for the badger uses only two of them in the ordinary way. If there is a badger in the neighbourhood he will soon give himself away by his tracks, which resemble those left behind by moles, but, of course, are much larger. If once pointed out to you, you

would always recognize the pincer-like marks left in the mud by his long claws.

Now and again one may come across the nest of a hedgehog in the bracken. He is supposed to be a weather prophet if we believe the old saw :

> Observe which way the hedgehog builds his nest
> To front the north, or south, or east, or west.
> For if 'tis true what common people say,
> The wind will blow the quite contrary way.

Do not be surprised if you come across a number of dormant snakes in the winter-time, lying with their bodies coiled around one another. They usually make their long sleeping-place in a hollow tree, among a bed of dry leaves. At first you would probably be frightened at their glassy stare, for the snake is one of those peculiar creatures which appears to sleep with its eyes open. The reptile has extremely thin and transparent eyelids which are always closed and only serve as a protection to the eyes. As these are transparent, we naturally conclude that the eyes are always open. All woodcrafters will, of course, learn to distinguish between the common grass or ringed snake and the viper. The former is much like a long green worm, possessing black spots and a yellowish neck. The following tabulated distinctions should be kept for reference :

1. The grass snake is much larger than the viper. (The former is seldom less than 22 inches, and the latter is seldom more.)

2. The grass snake is of a light brownish-grey colour with a greenish tinge ; the viper has a zigzag black line right down the middle of its body.

3. The under part of the grass snake's body resembles lead in colour, surmounted with black spots; this is absent in the viper's body.

4. The head of the grass snake is more pointed than that of the viper; the latter has a hammer-shaped head.

5. There is a faint V-shaped mark on the viper's head which does not exist on the head of the grass snake.

The woodland birds would well repay careful study. One hears the curious yaf-fil, yaf-fil, of the woodpecker as he clings to the bole of some rotting tree in search of insects; Nature's night-watchmen, the owls, glide through the air at dusk, and their homes may sometimes be discovered at day by the half-masticated pellets of fur and feathers which they have cast overboard down to the base of the tree; the pheasants, in many ways the cock o' the walk in the woods; the dove family, cooing away overhead; the magpie, jay, nightingale and cuckoo. Have you ever tried to lure a magpie by imitating his guttural chatter, or to set an owl hooting by blowing a flute-like noise between the thumbs of your hands? The art of calling birds and animals may easily be acquired with practice, provided one has a musical ear and a good whistle.

All woodcrafters will be quite proficient in naming trees, which they will distinguish not only by their leaves but by the bare twigs and bark. A young friend of mine has collected over fifty different specimens of leaves and preserved them in a book for future reference, and there is not a tree which he could not name correctly.

As a diversion in woodland studies one may play the game of "Indian Signs." Possibly there were no better woodcraftsmen ever known than the Red Indians, so well described by Fenimore Cooper, and when on the trail they laid a number of signs so that those following would be able to keep to the right direction.

This game may be played after the manner of fox and hare. Two cones, one placed upright in the ground, and the other carefully laid alongside, pointing down one of the paths, indicates the route taken. A bunch of tied bracken pointing in a certain direction, also may be used to point out the direction. Bent twigs may similarly be used, with the understanding that upright twigs stuck in the ground near a twig, each represents a dozen yards. For example, suppose that the free end of the branch points at right angles to your previous direction, and that there are four uprights placed against it, this would mean that you had to follow the new route for a distance of forty-eight yards. Arrows carved on tree trunks are very commonplace signposts. Two crossed sticks laid on a side-path show that this trail is not to be followed. Other signs will occur to the ingenious woodcraftsmen; they are all matters of arrangement beforehand, but much fun can be derived from this game.

After a few weeks of wandering about the long dim glades of the woods the book of Nature will be opened to you in a way you would never have imagined, and you will find woodcraft a healthy and a fascinating hobby.

MOTOR-CYCLING AS A HOBBY

FIRST and foremost I should advise the purchase of a single eylinder maehinc, and a solo (eyele only) outfit at that. The single cylinder motor-eyclc is the simplest form of petrol motor manufacturcd, and anybody with brains and care can very soon bceome suffieiently its master to drive it effieiently and earry out any minor repairs ; also, with one or two exeeptions, four horse-power is the limit of development for the " single," and that is quite enough power for the beginner to have bcneath him whcn he sallies forth on his initial journcy. The reason a solo mount should be chosen is bccause it is so mueh easicr to drive than a combination (cycle and sideear).

If it is intended to buy a brand-new machinc, any hints on purchase are hardly worth while.

But it is in the purehase of a sccond-hand bike that the care has to be exercised. Of course, you look over the bikc. Start with the framc and wheels. See that the alignment of the frame is good. If it isn't, drop thc matter at onec. Scc that the spokes of the wheels are good and sound. Jack thc bikc on to the stands and test the wheels by roeking them to and fro. If, after eone adjustment, there is still excessive play, the bearings arc worn and you should either abandon the business or reduce the price you are willing to pay.

Feel the under surface of the petrol tank. If it is wet the tank leaks. Test the head of thc bike

for looseness, and see that the handlebars are not cracked.

Examine the tyres. If they are worn, down goes your price, for you know you will soon have to spend money on renewing them. This also applies to the belt.

Now turn to the engine. Take off the belt and catch hold of the pulley. Rock it. Excessive play indicates wear in your bearings. If this shows, drop the purchase at once, because it means the beginning of trouble. Next, lift the exhaust valve and turn the pulley until the inlet valve stem is as low as it will go. Then take the tappet between the fingers and move it from side to side. Considerable movement denotes wear. The same thing can be done with the exhaust valve tappet. To test the compression of the engine, stand on the kick starter pedal, if there is one. Providing you don't throw your weight on to the pedal with a jerk, the engine should support you while you count five slowly. If there is no kick starter, jack the bike on to its back stand and either try to pedal against compression or endeavour to turn the back wheel with your hands. If you have difficulty in doing this, you may reckon that the compression of the engine is O.K. If, however, you find it easy, it means worn piston rings and low compression, and all idea of purchase should be dropped at once. The same applies if the cylinder is cracked.

A trial run is, of course, an essential part of the buying process, and it should be arranged that the bike has to climb at least one steep hill during this run. Watch her carefully while travelling; listen closely for "knocking," that little metallic sound

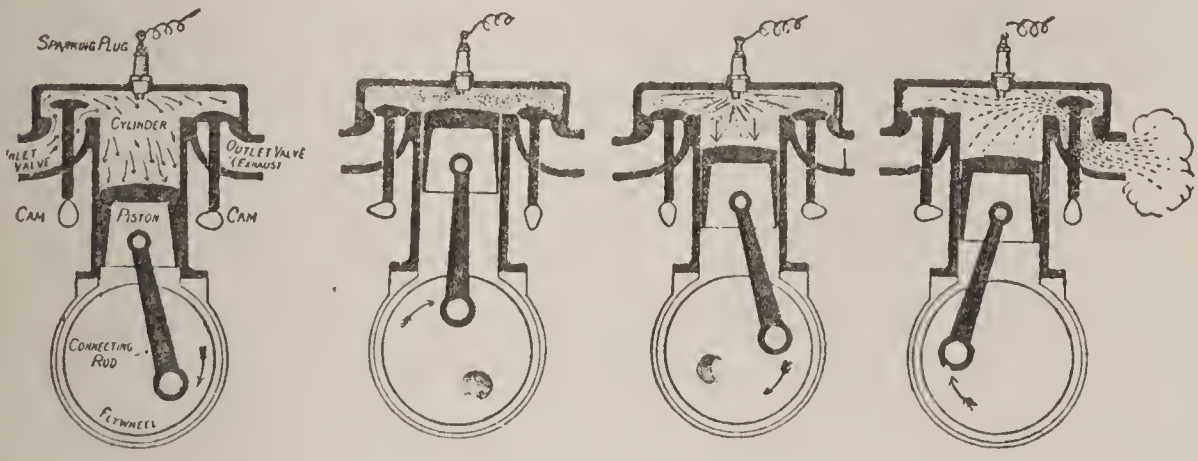
which rings above the explosions and gets so loud under strain, and also see if she tends to develop undue heat. On this trial run give her plenty of oil, and when you get back examine the crank case for signs of leakage or cracks. If the case is cracked you should not buy.

In the ordinary "four-stroke" engine—and this is the type most commonly in use—there are four distinct mechanical actions to every explosion of gas, and two distinct revolutions of the flywheel. When you think of a motor-bike roaring down the road, this will give you an idea of the tremendous speed of its internal happenings.

The cylinder. This is the engine in effect. It is the top part with the funny corrugations on its exterior, which corrugations, by the way, are designed to present a greater air service and so aid in cooling. Inside, the cylinder is machined to a marvellous smoothness. The top of the cylinder is shut right in, and the only outlets are at the bottom and through two holes in the side, these holes being fitted with valves called the inlet and exhaust valves. The inlet valve connects with the carburettor, and the exhaust valve, as its name suggests, with the open air; via the silencer. The purpose of the inlet valve is to admit the necessary mixture of gas and air; that of the exhaust to dispose of the exploded fumes. The bottom of the cylinder is fitted to the top of the crank case, and all communication with this crank case is prevented by the piston, a hollow cast-iron drum, circled with iron rings called piston rings, which fits the interior of the cylinder completely. This piston moves up and down, and is connected by

means of a pin called the gudgeon pin, with a long rod known as the connecting rod.

The connecting rod has phosphor bronze bearings at either end of it, in one of which the gudgeon pin works, the other end of the connecting rod being fastened to the crank pin down in the crank case. The crank pin is fixed to the flywheel, but "out of centre" of this wheel, so that an up and down move-



The "Four-stroke" Engine

1. Suction stroke begins: Inlet valve open. 2. Compression stroke completed: Both valves closed. 3. Power stroke begun: Both valves closed. 4. Exhaust stroke begun: Exhaust valve open.

ment of the connecting rod causes a rotary movement of the flywheel and of the crank shaft on which it runs, and to which is affixed the pulley driving belt, which in turn transmits power to the back wheel of the bicycle. Thus it will be seen that if the piston is moved up and down in the cylinder the flywheel will revolve, and the crank shaft with it, the pulley will turn, taking the belt, and in consequence you will obtain a revolution or part revolution of your back wheel. This is how the necessary movement of the piston is obtained.

Four movements of the connecting rod, or two revolutions of the flywheel, go to a complete circle

of events in working of the petrol motor. The four up and down movements of the connecting rod, or, to simplify it, of the piston to which it is affixed, may be stated in four words indicating the purpose of these oscillations. They are : inlet, compression, explosion, exhaust. This is how they follow.

The cylinder is empty. The piston descends, and as it does so it draws through the inlet valve a quantity of gas and air. It ascends and compresses this mixture in the top of the cylinder. When the piston reaches the top a spark from the sparking plug ignites the mixture, and the explosion drives the piston down again ; up it comes once more, carried by the momentum imparted to the flywheel in the crank case, and in its upward motion it lifts the exhaust valve and forces the exploded fumes through to the open air ; then on its downward path it once more draws in gas and air through the inlet valve, and the cycle of operations is repeated as before.

The carburettor is the instrument which converts the liquid petrol in the tank of the motor-cycle into gas, and, by combining it with the requisite proportion of the air, produces the highly explosive mixture by means of the firing of which the motor engine is driven.

It is divided into two portions, this carburettor, each of which is termed a chamber—viz., the float and mixing chambers—and the only connexion between these two is a very tiny pipe having a small opening called the jet. It is with the float chamber that we deal first.

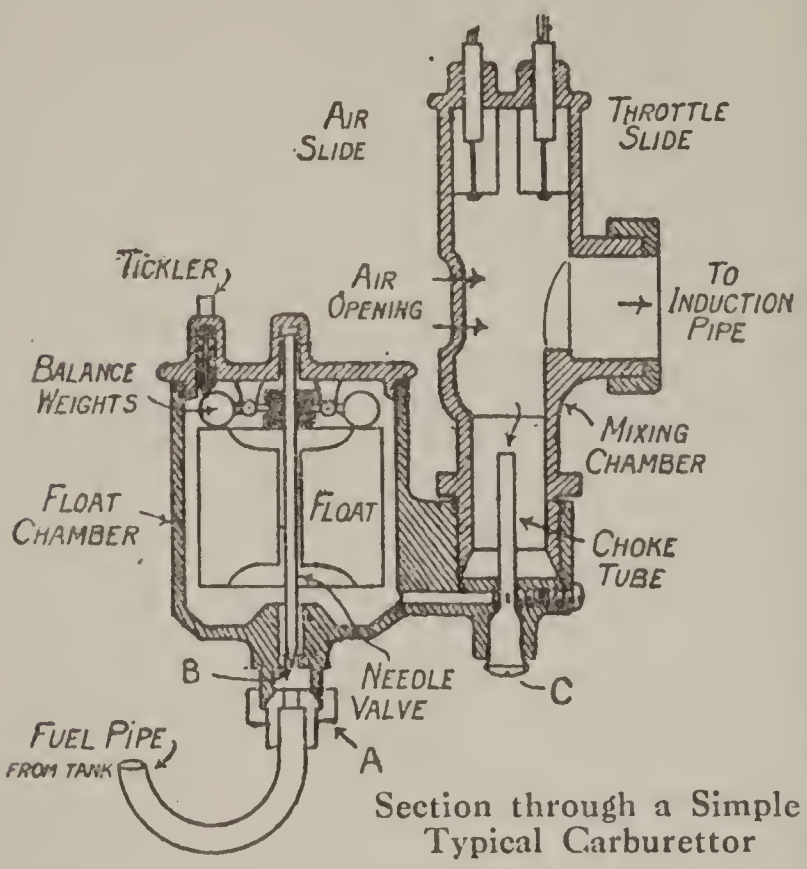
This part of the carburettor is connected with the petrol tank by the petrol pipe, which, by the way, is

constructed in the spiral formation so familiar to all in order to minimize risk of snapping under the constant vibration of the motor. The petrol is turned on, and the spirit flows from the tank up through the union in the bottom of the float chamber. Inside this chamber is the float. The float is a hollow circular metal drum, very lightly made, which, of course, will float quite easily on liquid. Passing through this drum, point upwards, is a needle of steel, and the point of this needle fits into a small hole through which the petrol has to pass directly above the union with the petrol pipe. It will thus be seen that when the needle point is inserted in this hole no more petrol can flow into the chamber. So the length of this needle and the lift of the float are adjusted so that when the requisite quantity of the liquid is in the bottom of the chamber, the floating drum is lifted, raises two small levered balls clamped to the needle, the needle is forced downwards, and the point inserted into the hole of the petrol union, thus stopping the flow. (*See* diagrams.)

At the bottom of the float chamber is a communication with the mixing chamber known as the jet, and as the petrol passes through the small orifice the float sinks, releases the needle from its position, and more petrol is allowed to flow from the tank.

This is the whole action of the float chamber, and we will now turn to the mixing chamber.

In this compartment the petrol, instead of, as in the float chamber, flowing through the top, is forced up through a narrow opening in the bottom. It is thus converted into a very tiny stream, and, being easily vaporizable, speedily becomes a gas. That is



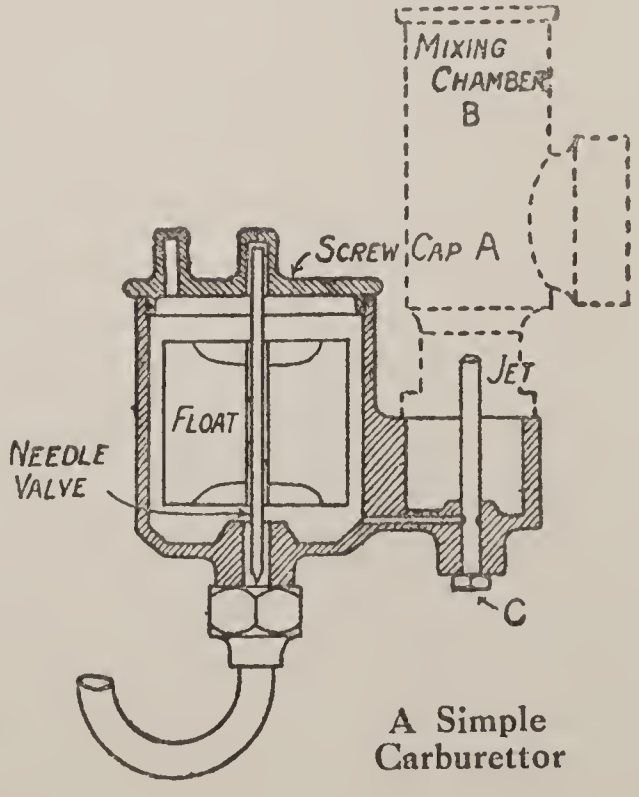
Section through a Simple Typical Carburettor

the object of having so small an inlet from the float to the mixing chamber.

Round the jet, at the bottom, are arranged a number of carefully sized holes having outlet to the open air, and as the petrol vaporizes, these holes admit the external atmosphere. They are most accurately gauged as to size, and permit of a mixture of gas and air in which the gas is in a proportion of about two and one-fifth per cent. The mixing chamber is now full of this mixture, and we wish to convey it to the compression space of the engine, as described in the previous article. At the top of the mixing chamber there is an outlet connected by a union to the engine, this outlet being comparatively large and covered by a metal slide, which metal slide can be worked up and down by means of a lever on the handlebars. This is the throttle. On the other side of the mixing chamber is a similar opening which is used as an inlet for air, this also being covered by a controllable metal slide. This opening, which is gauze covered to prevent the admission of particles

of dust, is the extra air port, and on the correct manipulation of this depends the efficiency of the running of the bike, as well as its economy of working.

However, to start the machine, in the majority of cases leave the extra air closed. " Tickle the float " —that is, depress the float by means of the little knob on the top of the float chamber provided for that purpose. This knob merely holds the float down and prevents it from closing the needle valve, and thus admits more petrol than usual to the jet, with the consequence that a heavier proportion of petrol gas is discovered in the mixture admitted to the compression chamber of the engine. You kick your machine into motion. The cycle of operations already described begins to take place, the inlet valve of the engine opens, and a proportion of the rich gas and air mixture passes into the cylinder head. It is fired by the spark, and the whole affair begins to work. The petrol in the jet vaporizes, the float drops, more petrol comes in from the tank, float lifts and closes inlet, and the whole thing starts again. Then, under the constant explosions, the engine begins to get hot, and it is time for the extra air to come into play.



A Simple Carburettor

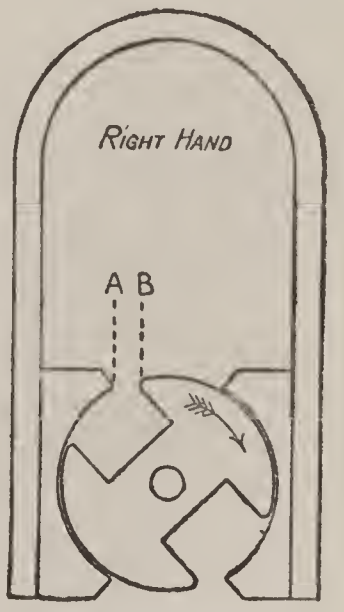
You open it steadily, manœuvring it until you find that you have got the correct position for it, and off she goes.

Ignition, as its name implies, has to do with the formation of the spark which ignites the explosive gas in the cylinder. The instrument which is used on all modern motor-cycles, with one or two notable and powerful exceptions, to produce the electric current by which the spark is formed, is called the magneto. It is with this I deal first of all.

Perhaps, in your physics laboratory at school, you have studied the question of magnetism, and therefore know that a magnet possesses a north and south pole. A magnet being a piece of steel bar bent to the shape of an arch or horseshoe, these poles are at either end of it. The piece of steel is highly electrified, and as a consequence it throws out "lines of magnetic force" which radiate from the north to the south poles in ever-widening curves like the ripples caused on the surface of a pool by the dropping of a stone. Thus, by bending a magnet we get a space, that between the two arms, filled with these lines of power. If you take a piece of metal which is a very facile conductor of electricity, say a copper rod, and pass it between the poles of the magnet, it cuts these lines of magnetic force, absorbs their power, and an electric current flows along it. If you pass it back again, the same thing occurs, except that the current runs in the opposite direction. So, if you want to obtain constant current from the magnet you must keep moving the copper bar across the magnetic field. This is exactly what is done in a magneto.

First of all a number of magnets, sometimes

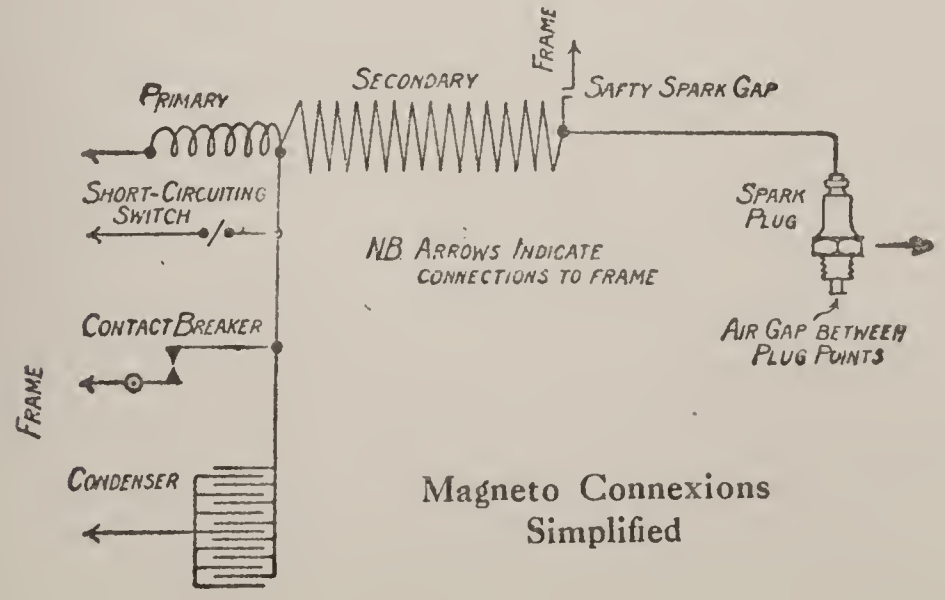
three, sometimes as many as six, are used. We deal with the six-magnet instrument as being the most up to date. Three of the magnets are fitted side by side, and the other three are slipped and screwed over them. All the north and south poles are on the same side. Between the poles of the inside magnets two solid pieces of soft iron are fixed, having concave surfaces machined in them. These are termed the pole pieces. A stick of soft iron is then taken, and copper wire is wound round this lengthwise. This arrangement is called the armature of the magneto.



A Magneto

A, Pole Piece
B, Armature

When the winding is completed the whole is fitted to a rod called the armature shaft, and inserted between the concave surfaces of the two pole pieces, the openings at each end being closed with brass plates. One end of the wire wound round the arma-



Magneto Connexions Simplified

ture is fixed to the frame, and the other, covered with some insulating material—i.e. a material which is a non-conductor of electricity—passes out through the hollow shaft armature, and is connected with what is known as the contact breaker.

Thus it will be seen that, should this armature be revolved rapidly, its wires will be constantly cutting the magnetic field created by its magnets between which it is running, and a constant current be set up. And this is exactly what occurs, the armature being turned by means of driving gear connected with the engine.

An electric current flows from one side of its generator to the other, or else to the earth. In the latter case, the current is known as what is "earthed." The pole from which it starts is called the "positive," that to which it returns the "negative." With a magneto the current is "earthed" one end of the armature coil being fixed to the frame which only "earths" it. If a gap is caused in the complete circuit between its starting and stopping points, and this gap is but a tiny one, an electric current, providing it has sufficient voltage, or, in simple language, pressure of running, will jump this gap in the form of a spark.

In the top of the cylinder is the sparking plug, an instrument connected with the magneto by a wire, and having a broken circuit at its nether extremity called the points. This end of the plug, of course, is inserted in the cylinder. At the magneto are two platinum points, which are affixed to what is called the "contact breakers," and these two points are separated by means of a tiny mechanism at the

moment when the pressure of current from the armature is at its highest. When these points separate, the current, under great pressure, flows swiftly along the high tension wire to the plug, jumps the points in the shape of a spark, ignites the waiting gas and returns to earth.

In the latest form of magneto, in addition to the first layer of copper wire about the armature, which is known as the primary winding, there is a second layer called the secondary winding, these two being connected, the object being to provide a high-tension or high-pressure current, and, consequently, a more dependable spark. Also the armature core, instead of as before being a sordid mass of soft iron, is made of thin plates pressed tightly together, this arrangement having been found to give more satisfactory results than the older one did.

By the way, a tip. If anything goes radically wrong with your magneto and you are no electrician, take it straight away to somebody who is, or you will make a mess of it. The magneto is a specialist's job, and very few motoring men understand it.

The timing of the valves of a petrol engine is at first sight a most fearsome job, when one is informed that the inlet valve must be arranged to lift when the downward suction stroke is in progress, that both valves must remain closed during the compression and explosion strokes, and that the exhaust valve must lift on the upward, fume-expelling stroke of the piston. And yet the mechanism by which this is obtained is the simplest possible.

Each valve is fitted to a long metal rod surrounded by a spring, the pressure of the spring being directed

towards keeping the valve closed. The valves on the best known English makes are placed side by side, are easily accessible, and simple in operation.

The rods, which are known as valve stems, descend from the valve head and rest on little metal tables topping other metal rods, these latter arrangements being named "tappets." The tappets descend into the crank case, and their lower extremities rest on right-angled pieces of metal which, in turn, run against a peculiarly shaped article called a "cam." A cam is just like a ring slid over an axle, except that one side of it is distorted and bumps out of the symmetrical.

On the crank shaft, or axle, of the flywheels driven by the piston is fitted a small cogged wheel. Enmeshed with the cogs of this wheel are two other cogged wheels, and fixed on the axles of these two are the cams operating the rockers or right-angled pieces, on which rest the valve tappets. The two cogged wheels driving the cams have twice as many cogs as the wheel on the crank shaft, so that this latter turns round twice to their once. By carefully setting the cam, it can be arranged that its bump is under the inlet valve tappet as the piston comes down. The bump lifts the rocker operating the tappet, the tappet moves upwards and the valve is raised from its seating. This piston comes down, turns the crank shaft, the cogged wheels revolve and the bump on the cam goes down, with the result that the valve returns to position. The same action occurs with the exhaust valve, and as the operating wheel on the crank shaft has only half as many cogs as the two which operate the valves, it has to turn round twice in order

to bring the cams into play, with the result that for one complete revolution of the flywheel, or two movements of the piston, corresponding to the compression and explosion strokes, the valves are shut.

That is the method of timing the opening and closing of the valves, and an examination of the gear on a bike in conjunction with these few notes will make it quite clear to anybody.

When two metals are rubbed together at high speed friction is produced, and consequently heat. Heat, in metals, means expansion, and expansion spells disaster when those two metals are part of the machine. With the tremendous speed of working of a petrol motor, it will be readily understood that the problem of heat is a very stiff one, and lubrication is a most important item in the operations of the motor-cycle. Oil has to be literally pumped into the crank case, and, once there, it is splashed about the interior by the speeding flywheels. In hand operated pumping gear I should advise about half to two-thirds of a pump per two to two and a half miles, but this may be varied a little according to the running of the particular machine on which you find yourself; but remember that over-lubrication is far better than lack of it. If you forget to oil your engine it is fatal, for the expansion mentioned above as being a product of heat generated by friction will surely take place, and the cheerful condition known as " seized up " will result.

So, unless you are sure, always err on the side of over-oiling rather than run the risk of constantly getting the machine over-heated and finally ruined.

To assist in the cooling of the engine, the top of

the eylinder is cut in corrugations, the objeet being, of eourse, to present a greater surfaee to the air, and in eonnexion with over-heating I would emphasize that it is always neeessary to drive with as much air as the engine will take, as a rieh mixture produees over-heating very quiekly, besides being expensive.

Transmission is the means by whieh the motive power generated by the engine is eonveyed to the baek wheel of the bike. Of eourse, the simplest and most known method by whieh this is done is by means of a pulley clamped on the exterior portion of the erank shaft, driving a belt which runs on a rim on the baek wheel. This is direet drive and is understood by anyone, but though it is simple it has the disadvantage that the gear is eonstant under whatever load of strain the maehine may be subjeeted to. In order to allow of low-powered engines taking heavy loads up hills a gear box is inserted between the engine pulley and the baek wheel, with a clutch between the gear box and the engine. The gear box is an arrangement containing a number of eogged wheels of various sizes, whieh ean be meshed at will by means of a lever, a smaller or larger wheel produeing a eorresponding differenee in the gear ratio, while the cluteh is a eolleetion of leather and metal plates, held together by powerful springs. When these springs are allowed to operate they eonvert the eluteh into a solid mass, but when they are distended by means of a eluteh lever the plates run loose and connexion with the engine is broken.

There is one thing which must be attended to at home, and a most important item at that, and that is

carbon deposit in the cylinder head. This is caused by the lubricating oil, which forces its way from the crank case past the piston, mixing with the impurities drawn through the extra air, burning and drying, and settling on the interior top of the cylinder and the piston. It is one of the greatest factors in destroying the efficiency of the engine, and if you find that the unit begins to labour under the lightest strain, you may depend on it the carbon deposit has something to do with it. In order to remove this deposit the cylinder head has to be taken off. Unscrew the carburettor and exhaust unions, undo the big bolts fixing the cylinder to the crank case, and tilt the cylinder backwards. Turn the crank shaft until the piston is at its lowest point and away will come the cylinder. The deposit on the piston head should be scraped off with a knife, that on the cylinder walls carefully removed with a chisel, caution being exercised not to damage the machining of the walls. Before removal of the cylinder, the engine should be thoroughly cleaned, to obviate the possibility of any dirt getting into the crank case.

Valves should be "ground in," i.e. made to fit absolutely close to the seatings, and all deposit removed from them at regular intervals. Badly seated valves mean loss of compression, and loss of compression, of course, is lost power.

The needle valve in the carburettor should be attended to occasionally to see if it is perfectly accurate in working, otherwise waste of petrol and high cost of running ensue. If it does not fit, grind it carefully until it does.

It is as well to run over all the joints of the engine,

such as inlet and exhaust joints, sparking-plug orifice, to make sure that they are compressing tight, as any little leakage there means loss of power, and in a small strength unit the tiniest wastage counts.

The bearings, both top and bottom, should be tested for play, and if there is too much of this, attention should be given them by a mechanic who understands his business.

The hubs of both back and front wheel should always be cared for, as ground-up ball bearings in either of these is a far more fatal happening on the road than the minor engine troubles one is likely to encounter. And yet the cycle parts of the machine are often neglected. I often, in walking about the streets, observe fellows careering round on motor-bikes with the front or back wheels wobbling, obviously indicating cones out of adjustment, and, as a result, completely ruined ball bearings, unless their luck shows them the fault in time. The head and wheels should be always properly lubricated.

Tyres should be gone over always between trips, and any jagged pieces of glass, etc., bedded in the outer surfaces taken out with a knife and the orifice filled with cover filler. Properly cared for tyres will give fifty per cent. more service than neglected ones, and with the rubber market at its present high standard, every week of running is a consideration.

And belts? I advise without hesitation a rubber belt. The rubber belt is cleaner, more reliable and absolutely no trouble. If, however, you have a leather belt on your machine, always bear in mind that leather, unless oiled, gets hard, and therefore treat your belt with castor oil in order to keep it soft

and pliable. A leather belt will be found to stretch a good deal, especially when new, and so, before setting forth on a run, always test it for slackness. When you return from a trip, whichever belt you have fitted, remove it from the belt rim so that all unnecessary strain, while the machine is not in use, is obviated. The advantages of a rubber belt are comparatively little stretch, no need for attention in order to keep in good condition, while the only direction in which a leather belt scores is it does not slip so much in wet weather; but the advantages of the rubber belt far outweigh this consideration. On all rubber belts will be found an arrow, this arrow indicating the direction the belt should run in when fitted, and care should be taken that the belt is so placed on the machine.

Attention should always be paid to the lamps and acetylene generators, the latter being kept well cleaned and in thorough working order.

It is a terrible thing to be broken down a dozen miles from nowhere and unable to locate the cause of the trouble. I wonder how many fellows there are driving motor-bikes whose sole knowledge starts and finishes with the notion as to which lever to move to make it go faster or slower or stop. Some, I'll warrant. So let us see what little things might happen on the road to convert our trusty old bus into a useless dead-weight.

First of all, and commonest of all, is the sooted plug. Burnt oil and impurities coat on the "points" of the sparking plug and, being non-conductors of electricity, do not permit of a spark. Results, no gas ignition, no explosion, no go. So when we first

stop unintentionally let us look at the plug. Take off the high tension wire and remove the plug from its seating. Place it on top of the cylinder and twist the high tension wire about it. Turn the engine and watch for a spark. No spark. Have a look at the plug. Sure enough it's sooted. Take a little tin box lid, run into it some petrol from your tank, and wash the points in the spirit. Try the plug again. Some spark! Screw in the plug and off you go.

But, suppose when you test first of all you get a spark? That shows that the ignition side of the machine is O.K. Another department has gone wrong. Just think a minute. There are two principal factors in the working of a petrol motor, the ignition and the gas supply. The ignition is all right, so turn to the gas supply. Petrol in tank? Yes. Come down to your carburettor. Try to flood it. Won't flood. Needle valve choked with some foreign substance, such as dirt or grit from the bottom of the tank. Remove the cover and clean the valve. If it floods, the jet may be choked.

Remove the chamber and blow through the jet to shift any tiny pieces of grit that may have lodged there. At the same time examine your float chamber for water. You will see it in little globules on the bottom. These little globules slide over the jet orifice, prevent the entry of the spirit and stop the bike. They should be carefully removed. Water in carburettor is the most fatal thing possible and every care should be taken to prevent its entry. If water is in your tank, and you will soon discover its presence, if, after cleaning out the float chamber, more water appears there, the only thing to do is to empty the

tank and filter the spirit. This can hardly be done at the roadside and the only thing possible is to get to a garage as soon as can be. With the modern tanks, however, the presence of water is hardly possible without culpable neglect by the driver.

Sooted plug and choked jet are two of the commonest causes of stoppage and can be rectified in five minutes, and, having described them, we will hark back to the ignition. Suppose that after cleaning your plug you still fail to get a spark. Take the cover from your magneto and examine the points. They are dirty. Clean them and adjust them for distance, ·4 mm. being correct. Still no spark. See if the rocker arm of the contact breaker is working properly. If it sticks, thin down the fibre bush it runs on until quite free working is assured. You will probably now get a complete and good spark.

You may be jogging along comfortably when suddenly the engine misses fire, chugs and stops. You get off and look at it in the usual disgusted manner. Kick her up again to see if she will run. She starts at once. You get on board and after she has run about twenty yards she stops again. This happened to me a little while ago. I tried the carburettor and found it all quite right; turned to the plug and located the trouble: the porcelain was loose and the electrodes kept shorting, so that the current, instead of passing to the points, went the quickest way and when the electrodes " shorted " I got no spark. Fortunately I had a new plug and so was able to rectify the fault at once. Therefore, when the above symptoms evidence themselves, try the plug, and if the centre is loose replace the whole thing without delay.

Sometimes, but not very often, a valve breaks. Of course, the only remedy is to replace it, therefore a spare valve should always form a part of your kit. Usually a broken valve can be located by the fact that the engine runs fairly freely with the exhaust valve dropped, indicating no compression.

The novice, especially the young novice, usually tries to show how particularly smart he is on a motor-bike, by tearing along at an awful speed down a tram-lined main road, hat off and head down, just to indicate that he is "one of the bhoys." But that is silly, it is dangerous, and it is not good driving.

And now for care. You can't be too careful. I don't want to convert you into a nervous bundle of femininity on a motor-bike, but I have seen too much of the trouble caused by reckless driving to let pass an opportunity to emphasize the need for care. If you are in doubt choose the safer course. Always pass traffic on the outside, except trams, which may be passed inside, and when those trams are stationary let your klaxon or horn go for all it's worth, because somebody is sure to step off the tram as though there was nothing else on the road except themselves. Avoid little children as you would the plague, even though they are on the path. They have a nasty habit of running off in front of you without warning.

Economy. That's the primary consideration after safety. We all want to do things cheaply in these days of high prices, and so economy must be the watchword when we hie ourselves forth for a ninety-mile spin. In a second-hand machine it is sometimes found that the petrol consumption is high. It is a good wheeze to test this consumption over a given

mileage, and if it shows a high figure for the make of bike (the makers will always let you have approximate figures for their machines), I should try fitting a smaller jet.

Don't drive the bike constantly at its ultimate speed. It is the worst thing possible for it.

Make use as much as possible of your ignition lever. By advancing the ignition you get a quicker fire at your plug, greater power, seeing that the explosion is actually compressed, and quicker running, without using more gas. So, after you have started up and your engine is getting comfortably warm, begin to open the air and shut down the throttle, at the same time edging forward the ignition. Manipulate the air, throttle and ignition levers until the engine appears to be doing her best, but never cease until you have your ignition as far advanced as possible, your air as wide as it will go, and your throttle closed down to the limit. Air and advanced ignition cost nothing, while an open throttle means used gas, and used gas is petrol.

When you go on a long run, especially through hilly country, nurse your engine for all you are worth. You don't want her to run hot at the first rise. Rush little hills but approach big ones circumspectly, and when you know there is a two-mile gradient ahead of you, let the old bus take it easy for a little while, give her plenty of oil and generally pet her up in preparation for her long pull. She will give you faithful service on the hill for all your little attentions when on the flat. As she labours up the slope, gradually open your throttle and close your air, at the same time retarding the ignition.

Experiment with the lubrication side of the machine, and although half to two-thirds of a pump-load every two to two and a half miles is a fair indication of what may be required for a hand-worked lubricator, every bike has her own requirements and you may find it necessary to exceed this in some cases.

Never start out without examining your brakes and seeing that they grip properly. You don't want to find out that they are faulty when you are running down a steep hill with a sharp turn at the bottom.

The rest I leave to yourselves. You will soon discover the best way to get the most from your machine, and if you always bear in mind that the better you treat a motor-bike the more it will do for you, you cannot go far wrong.

One tip for the road. Always be courteous to everyone you encounter, and if you see a fellow motorist in trouble, try to help him. You might want someone to play the Good Samaritan to you one day.

HINTS ON YOUR CYCLING HOBBY

FIRST the private motors and now the giant char-a-bancs have driven many "push-cyclists" from the main roads to the country lanes where these modern leviathans cannot penetrate, and thus the pleasures associated with the ordinary daily run to the sea, or some much-favoured spot, have sadly diminished for the fellow who likes to cover distance but cannot afford or is not attracted by the motor-cycle. And many there are, indeed, who still prefer the self-propelled method of travelling around to the worries and oily nuisances of the petrol-driven machine.

Where a tour is concerned, however, the cyclist need have no fear. The beauties of the countryside are still open to him, and by using main roads in the early hours, and cutting through the by-lanes during the busy times of the day, he may enjoy his holiday without being scared by the speedy and luxurious Rolls-Royce, or the crowded char-a-banc of the people.

Our old friend the horse may become extinct, your motorist may take to the aeroplane, but the much-abused "push-bike" will always be with us—he is a friend we will never throw aside.

Let us, then, contemplate our tour.

The first point under consideration is the state of your mount—second only in importance to your

own physical well-being. The machine must be thoroughly overhauled, and in Part 1 of this article I give you what, I think, will be useful tips, ignoring the obvious cleaning methods with which even the youngest cyclist is familiar. It is in the "doctoring" of the machine that a good deal of neglect is to be found.

HOW TO "DOCTOR" YOUR BICYCLE

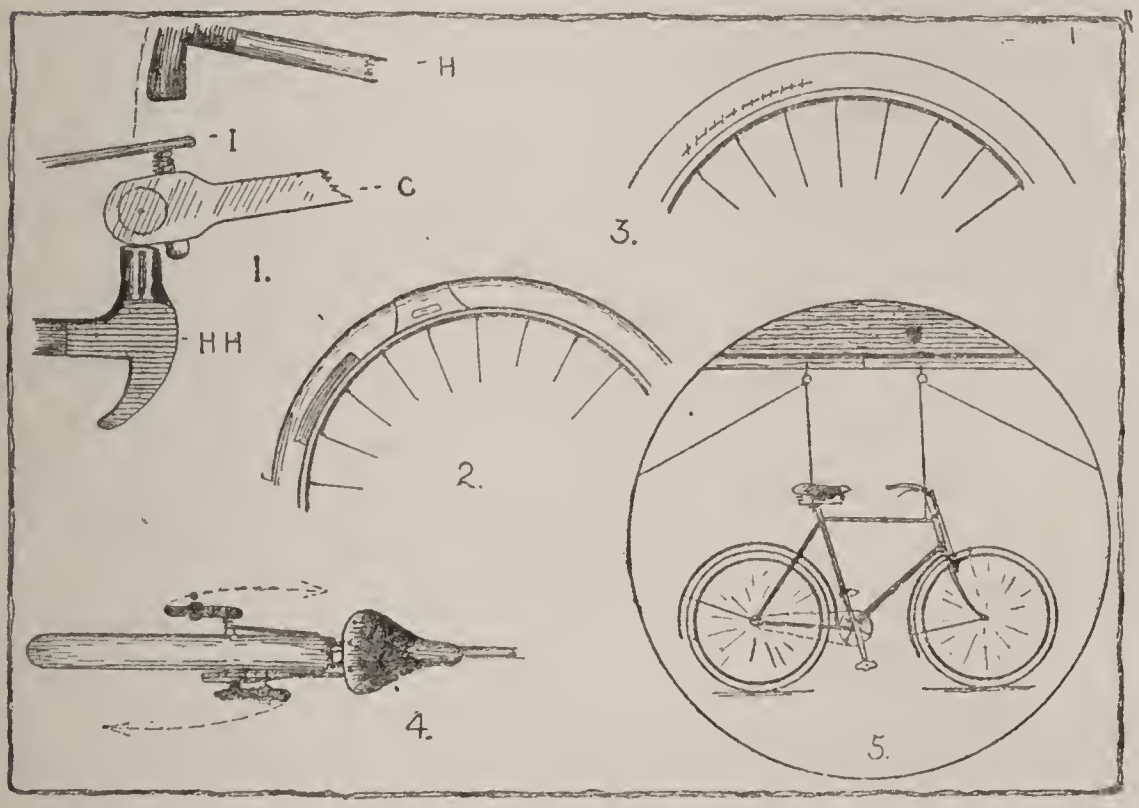
Although nearly every boy overhauls and paints his bicycle occasionally, if it is at all worn, few "doctor" their mounts. This needs some explanation, for the annual overhaul is supposed to cover everything in the way of renovation. What happens, however, only too frequently, is that the owner of the cycle cleans, paints, and polishes his mount, but leaves such points as adjustment, the care of the tyres, and other important details right out of his scheme of improvement.

It is not always necessary to re-enamel a machine, but it is all-important that such things as bearings, tyres, valves, and cranks should be kept in good condition.

Begin with the chain. Take it off, soak it in paraffin for some hours, rub it quite dry, then oil every link carefully. After the chain, see to the bearings, but I am not in favour of taking the bearings to pieces, unless it is absolutely necessary. Should they want adjusting take the matter in hand, but if you do not understand this kind of work, let a cycle dealer do the adjusting for you; it would be dangerous for me to try to describe the process to a

novice. Remember a bad accident might follow a blunder.

If, however, you understand the rudiments of adjustment, one or two hints may be helpful. For example, although many people tell me that they can adjust a back wheel with one spanner, I have never succeeded in doing so, and I have ridden since I was a boy of eleven. On most machines there seems



to be a distinct tightening of the bearings as you screw up the nuts—this should be allowed for. Perhaps my methods are old fashioned, but I always use two spanners to adjust a back wheel (see Sketch 4, the dotted arrows show the directions taken by the spanners). Remember, if a bearing is left too tight, the cones may split; this happened on one of my machines when I was a lad.

When pocket money is scarce tyres have to be

" doctored," for sooner or later holes appear on the tread, and they crack just above the wire or beading. Holes or cracks *off* the tread can frequently be doctored. For example, cracks can be sewed together with waxed thread (see Sketch 3), but some people just stick canvas round the tyre (see dark patch, Sketch 2), sometimes on the outside, which looks horrible and cannot be very effective. Large holes in the outer cover *on* the tread are a serious matter, and I fear there is no real cure for them that is within reach of the amateur. Probably the S.F. cross patch is the best remedy for moderate-sized holes of this kind, but, of course any outside patch makes the tyre a little " bumpy."

Few people know how to get a cotter pin out of the crank, but I have found the method shown on Sketch 1 most effective. H is the hammer with which you beat the pin ; I, a piece of metal to take the blow and save the top of the thread, and HH a heavy hammer placed under the crank to prevent jarring the bearings. To hit the top of the thread directly, will turn over the metal so that the nut cannot be replaced. I have seen people, who should have known better, bang nice machines about with heavy hammers in their efforts to extract cotter pins from the cranks; if the bearings go wrong after these attacks they just blame the maker of the bicycle.

The machine should be oiled, nuts tightened, and stones removed from small holes in the tread of the tyres—stop these holes with " tyre putty."

Sketch 5 shows a mode of hoisting your machine off the ground whilst " doctoring " it. Do not hang it as you would for enamelling; use two ropes and

two eyes (strong ones), as shown; you can then lift only one wheel or both off the ground.

OFF FOR THE TOUR

If you are setting out for, say, a week's touring, it will be necessary to carry, at any rate, some luggage, but let me advise you not to take more than you need. A few pounds carried over a part of the machine never intended for weight carrying will "slow" you more than twice the amount carried in the proper place. A good luggage carrier, fitted in the usual position over the driving wheel, and one of those admirable handle-bar "bike" bags, obtainable of almost any cycle dealer, will distribute the weights you must carry very evenly. Look at Sketch 1, there you have the ideal touring mount, but it should be mentioned that, although the gear case is a very comforting thing to have upon a bicycle, in these days of good roller chains it is not a necessity.

It will rain just when we do not want it to, and if one is perhaps a hundred miles out, it is just a case of putting up with the mud. Mud is a very nasty thing, it has a habit of flying round the guards until one's boots at the end of a run are simply soaked. It is far from pleasant to have soaked boots when away from home, and the side-guard, shown on Sketch 3, is well worth the small sum asked for it by cycle dealers. I believe a pair of these guards, one for the front and another for the back wheel, now costs about 3s. The flap for the front mudguard (Sketch 2) is useful if you do not fit the side-guards; it can be obtained

at any cycle shop; some people when pushed use a *cardboard* flap of this kind, but, of course, it is but the makeshift of the moment.

A speed gear is a blessing when touring, and will enable you to tackle most hills.

If you live in London and want a good touring ground within reasonable distance of the Metropolis, I suggest that you start about 4 a.m. for Basingstoke, thus leaving the Metropolis before traffic makes the going unpleasant, proceeding to Winchester, and thence on to Southampton. The roads are good, if a little bit hilly, but around Southampton they are fairly flat. After a day in "The Liverpool of the South" go on to Romsey, then through the New Forest to Lyndhurst, after which you might ride to Lymington. You can cross to the Isle of Wight in about half an hour.

This is but one of the fine areas open to the southern tourist, and the effort involved is fully worth while when one considers the glorious scenery around Alton, New Alresford and other places touched by the undulating roads which give from the heights panoramic views of surrounding country spread out on either side.

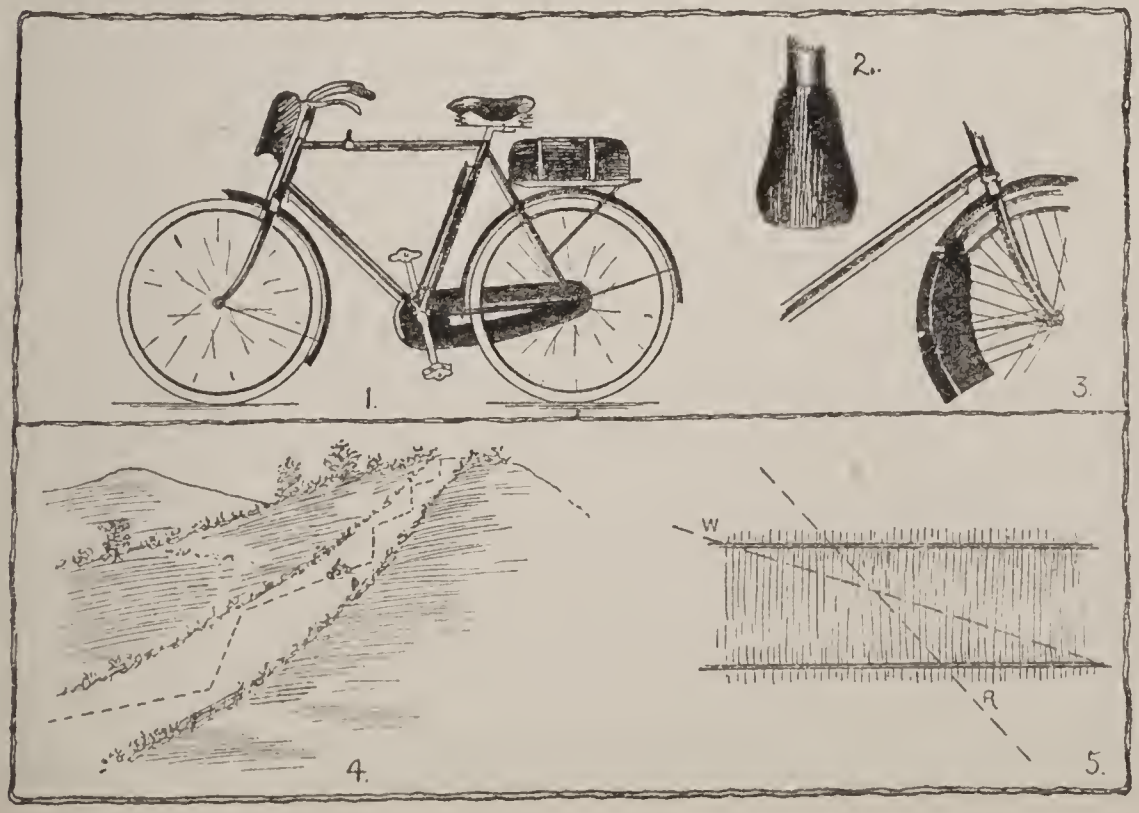
Save for the first-class metalled roads, those in Hampshire—and more especially Wiltshire—are not of the finest surface once you are off the beaten track. Sheep are largely responsible for this, so your tyres must be of the best. Cheap tyres were never an economy, and a series of bad punctures will upset the best of natures, even in holiday time. Another fascinating run may be made via Rochester to Canterbury, and thence through the coastal towns

of Kent and Sussex, where old castles and places rich in historical interest abound.

It is as well to refrain from making out a time-sheet in advance; rather should you progress easily according to your fitness, friends and fellows you meet at odd villages and with whom you may care to spend a little time, and the all-important question of good and reasonable accommodation.

Again, do not burden yourself with too much kit; I have always advocated the policy of sending soiled linen home by parcel post.

As regards daily mileage, about 110 miles can be achieved in a day—but not day by day. It is a good plan to start off with a really good day's riding (providing you are fit and have been using your mount fairly regularly), thus getting well away from your starting point. On "foreign" ground you can take your time and really appreciate the points of



interest in the towns and villages through which you pass.

Keep your rear tyre well pumped up when touring; nothing slows one so much as a slack tyre. Hills you cannot avoid, but have the pluck to get off and walk them, if they are too stiff for riding in comfort. It needs pluck sometimes to do this, but it is dangerous to attempt to ride a hill that is really beyond your powers. It is towards the end of the day that the hills begin to "find you out." When mounting long but not particularly steep hills, it sometimes eases the strain to work up in "taeks" (see dotted lines, Sketch 4). This zigzag mode of progression is very helpful at times. Beware of tram lines; never cross them as shown by the dotted lines W, on Sketch 5; R shows the proper angle.

Do not attempt to ride too many miles in the day; many tours are spoilt by so doing. Don't go too fast and stop when you are tired; that is the golden rule when touring.

GEOLOGY AS A HOBBY

FOR the fellow who has not much cash to spare with which to buy expensive apparatus and things of that kind, and who takes an interest in things scientific, and loves Nature and the open air, geology is an almost ideal hobby. Almost everywhere he goes he will find something to interest him. Railway cuttings will be more than mere trenches in the earth, and he will never be able to pass a sand or clay or chalk pit without stopping to investigate. If he is one of those who go for a seaside holiday each year he will not know a dull moment from the time he reaches the water's edge until he comes away again.

Geology is the science that tells us the history of our earth from those tremendously far-off days when it was a red-hot, glowing mass, until the present day when it is almost solid and comparatively cold. Not so cold as the moon; but very cold when compared with the sun.

Practically speaking, all the rocks and all the soil of our world have been deposited by the action of water. The exceptions are those of volcanic origin which have been thrust up, at some period or another, from the earth's molten interior. Such *igneous* rocks may be seen in Cornwall, round Land's End, and in the mountain masses of North Wales, Scotland and Ireland, to name a few places.

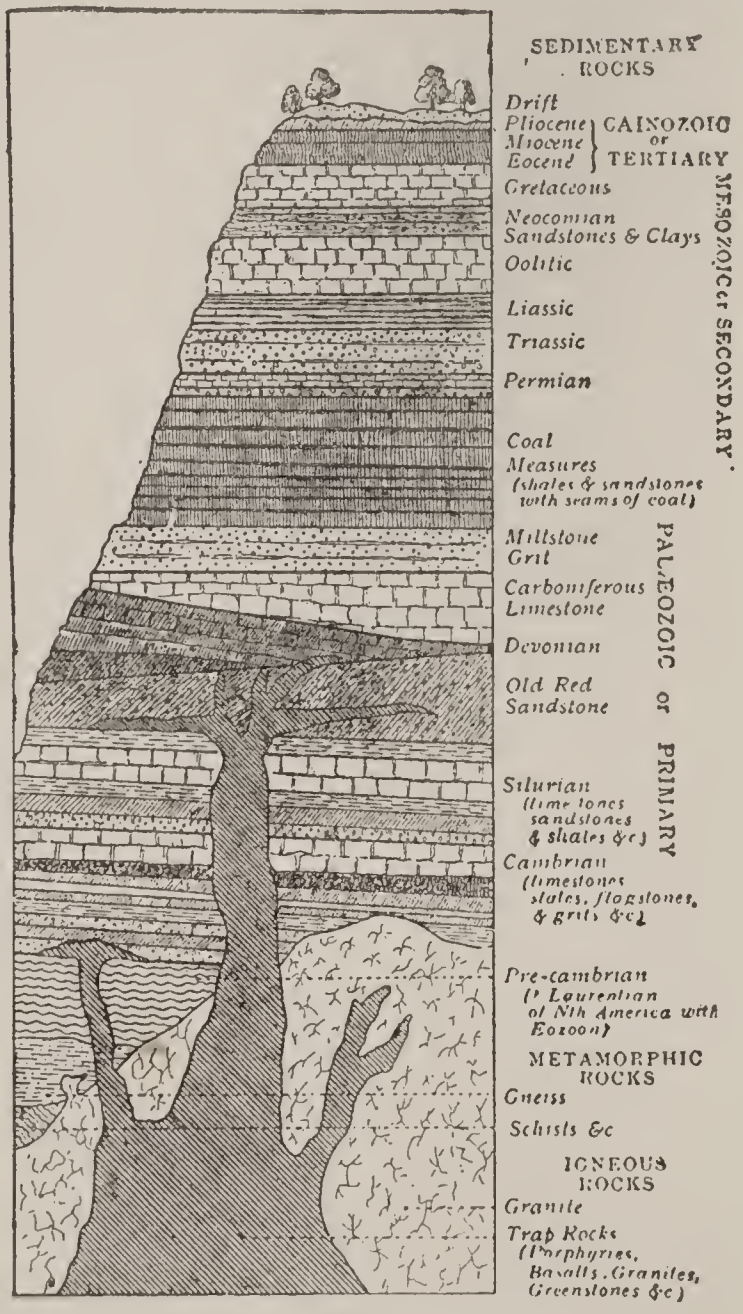
From the igneous rocks you may collect beautiful specimens of crystals and crystalline formations;

but, from them, you will not be able to read mueh geologie history. It is the water-deposited roeks that are the most interesting, for they eontain *fossils*, or animal remains that have been turned into a kind of stone, and preserved through eountless ages. From these fossils seientists have been able to traee the gradual evolution and perfeeting of life on the earth, and by means of these fossils you ean tell to what period of the earth's history any partieular deposit belongs.

In the beginning, as the earth eooled, a tremendous quantity of water vapour was evolved and aeeumulated in great eloud masses. Presently these clouds broke and deseended in tremendous, drenching storms that swept bits and partieles of the higher portions of the erumpled surfaee into the valleys. Thus we have the beginning of the *stratified* or water-deposited roeks. Nobody knows, nobody ean tell, how long a period of time has elapsed since these first stratified roeks were left in the larva valleys of the eooling earth surfaee by the awful storms of the early atmosphere. It may be eighty millions of years—or it may be eight hundred millions of years.

Nor do we know when and how life began on the earth. Mr. H. G. Wells, in his wonderful " Outline of History," suggests, and here he is baeked by many eminent authorities, that the first life was a kind of green seum that came into being on the edges of the first lakes and seas. The early stratified rocks bear no traees of this early life, for it had no hard parts that eould be preserved. It was only when the living organisms began to develop

shells and skeletons that their remains were preserved through countless ages to tell us the wonders of the youth of the world.



Story of the Earth

Geologists have now placed all the stratified rocks in order, or sequence, according to the gradual evolution of the remains of life which they contain. There is still a great deal of work to be done, though, and the humblest student, provided that he knows what he is looking for, and what he is looking at when he has found it, may make a big discovery. It is not so very long ago that a youngster of nineteen made a discovery of the utmost importance in the Isle of Wight, where he was spending his holidays, and was called before the Geological Society to describe his discovery and exhibit the

fossils he had collected. It might easily be your luck to find out something unknown before.

We have said that one of the chief recommendations of geology as a hobby is that it is very cheap to indulge in. You do not require any expensive apparatus. You can, in fact, do quite a lot of fossil collecting with nothing more than a strong clasp-knife and a lot of old match boxes in which to store the smaller of your specimens. If you are going to work on any but the softest rocks, though, you will need some sort of a hammer, with one end shaped like a small pick. It is possible to get coal hammers weighing between one and two pounds that are just the thing. For working in softish sands and clays an old garden trowel is very useful.

Fossils are almost always the remains of sea, or river, or lake-dwelling creatures that have lived and died in the water and whose harder parts have been covered by sediment before they disintegrated, or the remains of land-dwelling creatures that have been drowned or have been swept or fallen into the water after death. In this case, too, it is usually only the hard parts that have been preserved, such as horns and bones and things of that kind. In the case of vegetable remains it is often only the *impression* of leaf or branch or twig that remains, the actual material having entirely disappeared. In some cases, both vegetable and animal, the original material has been entirely replaced by some new mineral of a harder and more durable nature.

Directly you begin to collect fossils you will want to know to what period of the earth's history

your finds belong, and so we cannot do better than discuss the main chapters of that fascinating history now. These main chapters have been given rather hard names; but as they are understood by geologists all over the world it is worth while to remember them and use them. Without troubling about any but the most important of the subdivisions, the following list will give you a groundwork on which to build your knowledge as you acquire it.

Part of one of the ferns of coal

THE MAIN ROCK CHAPTERS IN THE WORLD'S HISTORY

The Azoic (Lifeless).—The earliest water-formed sedimentary or stratified rocks. Not much in evidence in this country, but great surfaces of them are exposed in Canada.

The Proterozoic (Beginning of Life) Rocks.—Sedimentary, but much altered by heat and pressure like the Azoic. Vestiges of simple plants and markings that may have been made by worm-like creatures have been found. Also the skeletons of microscopic creatures.

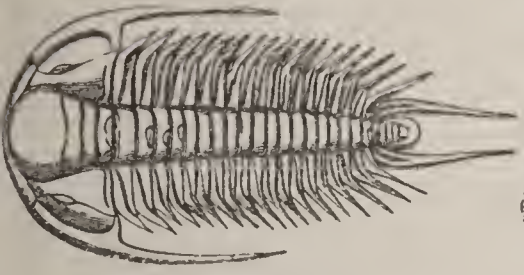
(Note.—These two divisions probably account for some hundreds of millions of years of the earth's history. Associated with them are those rocks called Fundamental Gneiss, found in the Isle of Lewis and elsewhere, which are supposed to be the actual rocks which formed as the red-hot world cooled, and from which the earliest sedimentary rocks were washed by the torrential rains and thunder-storms of the world's youth.)

The Palæozoic (Ancient Life or Primary).—These were mostly of marine origin; that is to say, they were deposited beneath early seas. They are divided into two series, the Lower and Upper, and in this country are to be found in Shropshire and Wales. The fossils to be found are mostly shells, remains of sponges, and such like. A very wonderful thing about some of the shells is that they belong to families like *Lingula* and *Rhynchonella*, of which living species are still to be found in the sea. Ripple markings formed by tides millions of years ago are sometimes found near Church Stretton, and in other places where these rocks are exposed. One of the characteristic fossils of the Palæozoic Series is the Trilobite. They were something like the Woodlice of our own days, but lived and swam in the sea. The Upper Primary contain Old Red Sandstone and Devonian Series, and the famous Carboniferous or Coal-measure Series. This represents a long period, some millions of years, of conditions that favoured the growth of dense forests rooted in swamps. The animal life was represented by shell-fish in increasing numbers, with heavily scaled swimming fish and amphibious creatures like gigantic newts.

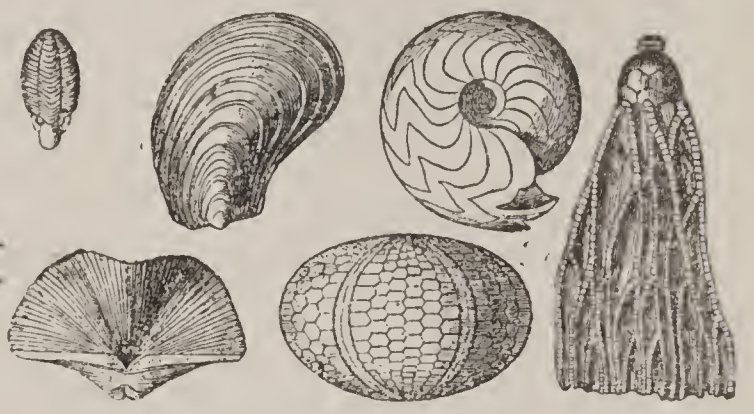
The Mesozoic (Middle Age or Age of Reptiles) represents another space of some millions of years. During this age reptiles flourished and grew to gigantic proportions. There were, besides, any amount of shell-fish. Rocks of the Lower Middle Age may be found at Swanage, Lyme Regis, in Gloucestershire, Sussex, the Isle of Wight, and many other places in this country. These rocks are generally called the "Oolitic" Series. The Upper Middle

Age is represented in this country by the enormously thick chalk formations and the green sands.

The Cainozoic (Recent Life—the age of mammals) represents another period of some millions of years and brings us up to historical times. Evidently some great change in the world's climate led to the rapid extinction of the huge reptiles of the previous age, for they utterly disappear, leaving but a few mean representatives behind. We still find shells in the deposits, any amount of them, and very beautiful some of these fossils are; but the characteristic fossils are the bones and teeth of mammals. It is usual to divide the Cainozoic or Tertiary period into four. The earliest—the Eocene (dawn of recent



The Trilobite



Fossils of the Carboniferous System

life)—is a special favourite with geologists living in and near London, for it consists of the London clay, the Woolwich and Reading Beds and the Thanet Beds, and some wonderfully prolific beds in south Hampshire and the south-west of the Isle of Wight, where the young scientist can pick up fossil shells from the cliffs to his heart's delight. The Miocene, the second period, is hardly represented in this country. The third period—the Pliocene—can be well studied as to its fossils in the Norwich crags and red crags, whilst the recent and Post-Glacial (after the Ice Age) beds afford some grand excitement in the finding of the bones and teeth of the mammoth and the flint implements of early man. I have myself found many mammoth bones and teeth and flint "scrapers" in the brick earth pits near Crayford in Kent. It should be

mentioned that the Cainozoic Age was a time when the surface of the earth shrunk and crumpled very much. Most of the great mountain ranges were extruded during this age.

So mueh for the main outlines of our earth's history. For more eomplete details you will have to go to a good textbook of elementary geology. I ean reeommend that by Professor Geikie, but any *elementary* work will serve your purpose.

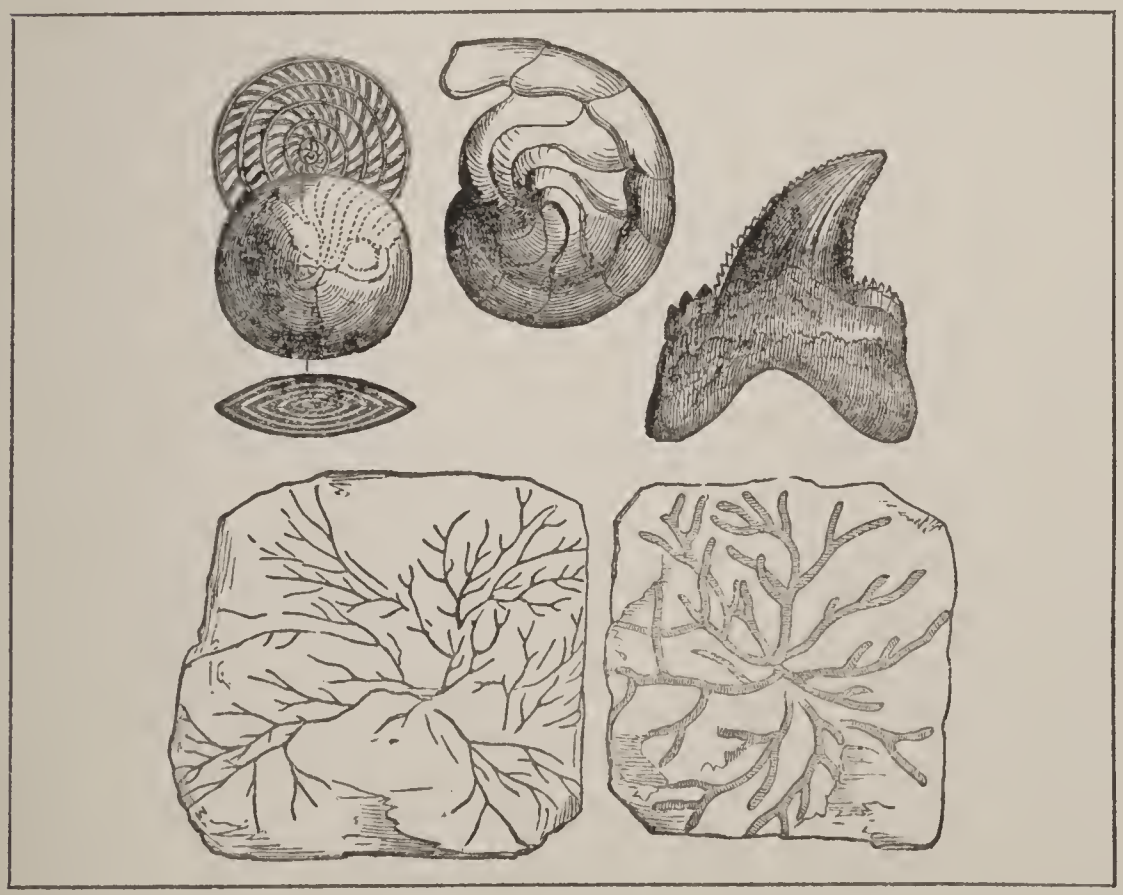
And now it is high time that we wcnt out on a real geologizing jaunt. Let us paek a haversack with the esscntials. We shall want a dozen or so of old matchboxes, each with a pieee of whitc paper pasted on the lid, and some of them stuffed with cotton-wool. A eouple of newspapers should also be packed, in casc anything big should come our way and nced packing carefully to prevent it from getting chipped or broken. The hammer will be in the bag for a start, and in our poekets we each carry a stout knifc. One of us has that garden trowel of which we spokc previously—it can go in the haversaek if there is any room.

We are going to Herne Bay for our first trip, because it is one of the plaees where the interesting London clay crops out.

As we journey down thcre in the train let us have a little chat about strata and the curious ways in which thcy lie. If the various stratified rocks had rcsulted from an even layer of water all over the earth they would have been in level layers, and we could not have got at any but the topmost ones save by mining or burrowing. As we know, the very first deposits were laid down in valleys in the crumpled

surface of the earth, and ever since the earth's crust has been crumpling and contracting, so that what was a valley at one period might be on a mountain top during the next.

Also we must remember that differences in climates through the ages, sometimes quite hot and sometimes very cold, have made a difference to the extent of seas and lakes. In a very cold period much of the water was solidified in the form of ice, and the seas receded when the ice did not melt. All this has resulted in a happy state of things for the geologist, in that at some place or other it is possible to find nearly all the pages in the earth's wonderful history from the first to the very last.



Eocene Fossils

This state of things has been aided by the big upheavals of mountain chains during early recent times—ancient when compared with history, but recent when measured as a geologist measures time. The "everlasting" hills that we know are only recent features of the landscape to the geologist. When the mountains were thrust up they crumpled and tilted all the strata that were not already tilted and crumpled.

The geologist has to learn to measure the dip and inclination of the tilted strata. If he has much experience at his hobby he can very often make a very shrewd guess as to how deep beneath the neighbouring strata that particular one will go, and where it will come up again. This is very useful in mining and prospecting. Of course, you know that the chalk runs right under London, and appears on the surface both north and south of the metropolis. The London clay lies in a cup of chalk and appears again under the New Forest.

When we reach Herne Bay we go at once to the shore and examine the clay cliffs. If we keep our eyes open where the clay meets the shingle of the shore, particularly where there have been fresh falls, we shall soon be rewarded with our first fossils. These will probably be the teeth of a species of shark and may measure anything from half an inch to two or three inches from tip to crown. The remarkable thing about these teeth is the freshness of their appearance. It seems almost impossible that they are at least a million or two years old. They look as though they had just dropped out of the jaw of a recently killed sea-tiger.

There is no need to be particularly careful of these teeth. They will not break, and there are lots of them. Fill a matchbox with the best specimens and carefully label it "London Clay, Herne Bay," and the date. Always label your box directly you have placed a specimen or specimens in it. There is nothing more annoying than to forget where you got a particular specimen from.

Now we will proceed to look for other treasures. From the London clay we may pick a few specimens of fossil wood and fruits and a shell or so. Also we will keep our eyes open for the Thanet Sands, which also crop out hereabouts. They may yield the fragile shell of a nautilus, which will want packing in cotton-wool at once, as well as other shells of tougher build.

The great thing about a geological expedition is always to keep your eyes open. I have known three or four persons who were supposed to be keen geologists pass over a treasure that was absolutely sticking out of the earth asking to be picked up. You need keen eyes and you should know how to use them. Nothing should escape you.

Part of thin slice of Limestone (Carboniferous)

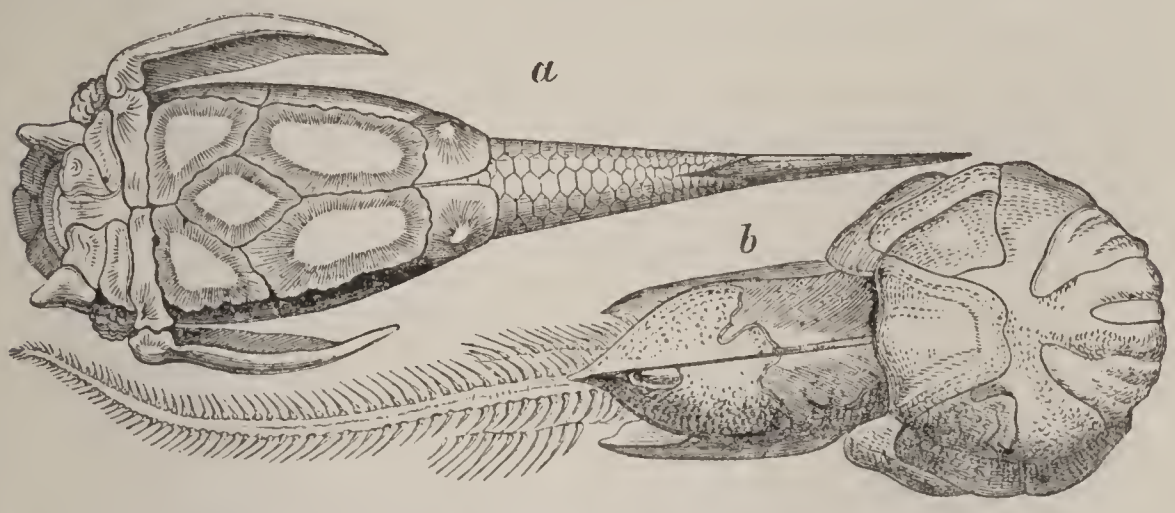
If you come upon a specimen just exposed on the surface, do not plunge at it and try to drag it out, even if it is in clay or sand, or you may break it. The proper way is to work it out

carefully, with knife, trowel, or pick, according to the hardness of the medium, working several inches from the specimen and feeling carefully all the time in case another specimen is lying hidden close to the first. When you have it lying in your hand, you can clean off the worst of the material clinging to it and pack it in two or three sheets of newspaper, or in one of your boxes.

When geologizing in such places as Freshwater Bay, in the Isle of Wight, where specimens can often be picked up by the handful, you need not worry about keeping them separate in your boxes. See that there is sufficient packing in the box to prevent delicate shells from breaking by rubbing and knocking against one another, and leave the sorting till later on.

Though hunting for specimens and finding them is great fun, I think that identifying and mounting them is better fun still. Directly you have your first specimens you will want to find out what they are, and you should lose no time in visiting the geological section of your local museum, if you have not already done so. You will there see the best method of mounting and exhibiting your specimens. You will also be able to find out the Latin or scientific name of your specimen. If you are in any difficulty do not hesitate to ask to see the curator of the section. These gentlemen are only too glad to help the beginner in every way. You will pick up any amount of information from them if you only remember to ask intelligent questions, and then listen with ears wide open.

You will probably find that the specimens in



Fishes from the old red sandstone of Scotland
a. The Winged Fish. *b*. Fish with cranial buckles

the museum, cleaned, and in some rare cases, such as the Thanet sands fruits, soaked in paraffin wax that has been melted almost to boiling point, are mounted with a little fish-glue on a small square of board on which a piece of grey-blue paper has been pasted. Beneath the specimen is a label on which is printed or written the name of the specimen, the formation and the locality in which it was found. Like this—

OSTREA BELLOVACINA

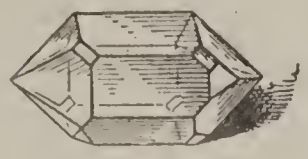
London Clay. Herne Bay.

This tells anyone who looks at the specimen that it is an oyster of the named species, and that it was found in the London clay at Herne Bay. Some collectors add in small figures the date the specimen was found.

As your specimens increase it will be most convenient to keep them in nests of drawers, and soon

you will find that you have sections containing a few specimens from nearly all the main divisions of the earth's history, with a specially large section of the fossils of your own district.

As soon as you possibly can make friends with other geologists. You will then rapidly enrich your collection by exchange, and though there is nothing like finding a specimen all by yourself, it is nice to have specimens from parts of the country you are not able to visit.



A Quartz Crystal

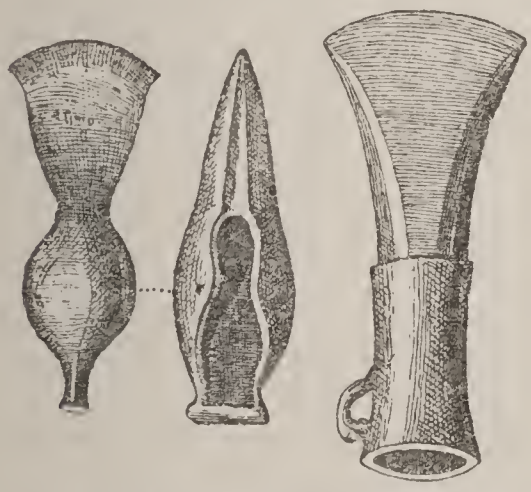
In many of the technical institutes of the big cities there are classes in geology held during the winter. If you are lucky enough to be near such an institute join the class for the winter months. That is the way to learn and to make friends with people who have the same tastes as you yourself have.

If you make geology your hobby it is not necessary to confine yourself to *Palæontology*, as the collecting of fossils and the study of the succession of life on the earth is called. Many fellows find searching for and collecting minerals more interesting; but they are usually those who live in districts where there is an abundance of volcanic or igneous rocks. I think that a small collection of mineral specimens should form part of every geologist's collection. Nicely mounted crystals shining in the light always look brighter to the casual visitor than fossils, which seldom have any colour but a dull brown or grey. When people who do not understand geology wish to look at your collection, it is worth while to have something pretty to show.

If you are keen, you will find that as you progress

in geological knowledge you will have to extend your studies. Geology is the most liberal and least specialized of sciences, and that is another reason why it is a good hobby for the fellow who likes science but can only give a portion of his time to it. You will find, before long, that you are making excursions into the realms of chemistry and zoology and comparative anatomy.

In this chapter it has been impossible to give more than a hint why geology is a good and interesting study to take up, and to give you the main outlines of what it is and how you can set about collecting. At first you will probably be very bothered to tell what your fossils are, beyond the fact that they are shells or bones or of vegetable origin. Very soon, though, particularly if you visit museums, you will find yourself identifying the main



Celts from the Lacustrine Habitations

A Corkscrew Fossil

shell families very easily and naming your specimens at once.

A final hint goes back to the question of the

amount of eleaning you should do to your speeimens. This depends very largely on the deposit from whieh it was taken, and the state of preservation. Shells from the Eoeene of the Isle of Wight are usually perfeetly elean direetly they are dry and you have shaken the dirt from them, as are bones from the Kentish briek earths. Fossils from harder roeks will need very eareful chipping with knife and possibly chisel to get away the maximum amount of the *matrix*. Your aim should be to have a elean-looking speeimen, showing all its charaeteristies, without unduly weakening it. Do not diseard a broken speeimen. It may be rare even in a broken state, and you may never find a eomplete speeimen.

People who are recommended to take up geology as a hobby oeeasionally ask what there is to be made out of it. The answer is that nothing is to be made out of it, save many happy hours and a great deal of knowledge. If you have plenty of time to devote to it and are elever with your fingers, so that you ean turn out really exeellently mounted specimens, you may find a market for your duplieates with one or other of the natural history dealers. You will obtain their addresses in sueh papers as "Nature," and in the official organs of the Geologieal Soeiety and the Geologieal Assoeiation. Membership of the Soeiety gives you the right to put "F.G.S." after your name; but you must have done some good work for the seience before you can be eleeted. Anyone who is interested in the seienee ean join the Association, and very well worth while it is to join. The address of the seeretary is Geological Society, Burlington House.

ANGLING

ALTHOUGH the tackle used should be the best that one can afford, it is a mistake to think that expensive rods, baits, and reels, will mean more fish. Costly tackle is only better made and possesses more refinements than the cheaper kind, which naturally makes it more pleasant to handle, but this—with the exception of fly rods—should not trouble the average boy. I pulled out the best pike I ever caught, with my son's rod, which cost five shillings, whilst my own was being varnished.

However, a good rod will outlast several inferior ones, and some indication of the price of them may prove interesting. A bottom-fishing rod may be purchased from 12s. 6d., which will serve for all ordinary coarse fishing. In no case should more than £1 be paid for a rod of this description, and at that price it should be a first-rate one. A spinning rod may be purchased for £1, which will give good service, if it is varnished once a year with some good clear boatmaker's varnish. I would, however, recommend the angler to spend a shilling or two on the purchase of a set of porcelain lined rings, which he should substitute for the brass ones which will be fitted when purchased. Brass rings wear very quickly, through the friction caused by the line passing over them, and after a time, quickly wear the line. Porcelain rings allow the line to slip through without any friction, and the line will last

ten times as long as it would if brass rings were being used. A fly rod can be bought for £1, but it is not a useful tool, being as a rule cheaply ringed and badly balanced. A better plan would be to expend the same amount on a second-hand one, which may be of greenheart or split cane. A split cane one is the angler's ideal, but as a rule is the most costly of all. They can, however, be picked up cheaply at times; I had one offered to me last season for 30s., which cost £5 the previous year. For a roach rod, 12s. 6d. will be ample, and should be a good one at this price.

Except for fly rods, I do not care for one made of all greenheart, it being too flexible for the lower parts of the rods. For top joints it is splendid, as it can be drawn down to an exceedingly fine size without becoming brittle. Ash and willow are generally used for the second joints or butts, but East India cane also makes a very nice rod, which although stiff, will give to the frantic plunges of "that big one" when you hook him.

The top and bottom rings of rods, other than spinning rods, from their meeting with the greatest friction, should be of steel and not brass, for inexpensive rods. Bridge rings are preferable to snake rings.

Reels or winches are usually made of metal or wood, although in the more expensive types, ebonite and aluminium are used for lightness. As the reel is a most important consideration—for a day's sport may be spoiled by an inefficient winch—it is false economy to buy a cheap reel. For fly fishing a light all-brass $2\frac{1}{2}$-inch reel can be purchased for

12s. 6d., which can be depended upon, or second-hand it might be picked up for 5s. It should be fitted with a check both ways. For spinning, a 4-inch reel, which will give satisfaction, can be got for as low as 6s., fitted with a check action which can be disconnected for the casting.

Here again, it pays to buy a good reel, and if one of the centre-pin type can be purchased second-hand, it will give endless satisfaction, and last a life-time. A very much longer cast can be made with this type of reel, and it can be got second-hand for as low as 10s. 6d.

Now, as regards lines, buy the best obtainable. Cheapness here is money wasted, as the quality is bad, and they very soon become unreliable after immersion in the water. A silk line costing 3s. 6d. will outlast half a dozen hemp ones, and you always have the comfortable feeling that such a line will hold any fish which you are likely to catch. For spinning, a dressed silk one is far the best, as it does not tangle so easily as an undressed line, should it chance to overrun, neither does it twist up through the action of the spinner in the water, as does the undressed line. A dressed line is certainly some 2s. dearer than the undressed, but you will save more than two shillings worth of temper by the initial expenditure.

Lines, whether dressed or undressed, will quickly rot and become unreliable if left to dry on the winch. For this reason, however tired you may be, always make a point of unwinding the line after a day's fishing, in order to give it a chance to dry. The best method of doing this is to wind the line round and

round the back of a chair. Undressed lines are improved and made waterproof by rubbing with a dressing each time after use (when dry), made by melting half a wax candle in a sixpenny pot of yellow vaseline. It should be well rubbed in, and the surplus afterwards rubbed off with a clean cloth. Dressed lines naturally do not require this attention.

For bottom fishing, gut is required, and here again it pays to buy the very best. Cheap gut is dull-looking stuff, which frays quickly where the hooks are bound on, and parts at most unexpected moments. Good gut is clear and transparent, and has a high polish. However, money is a consideration to the average boy, and cheapness may appeal for this reason. There is, however, an excellent substitute for gut which will do all that gut will do, and has advantages which the real article does not possess. This is about one half the price of the real gut, and is named gut substitute. Having found one so very reliable, I have not tried any other make, —and there are several, but the brand known as Jagut, and manufactured by S. Allcock and Co., Ltd., of Redditch, is an absolutely dependable article. It will hold anything, provided the right gauge is used, and lasts practically for ever, never fraying as does the real article. One caution is necessary when using the substitute, and that is it must always be soaked for at least half an hour before tying. Number 13, which has a breaking strain of 27 lb. dead weight, costs ninepence for five yards, and will hold the most ferocious pike you are ever likely to get hold of. The finer grades are cheaper still, number 5, which has a breaking strain of 11 lb., costs about one penny

a yard, and is about the right thickness for making up fly casts.

I need hardly touch upon fly fishing, as the average boy does not get a chance to use this type of bait. There is very little free water where a fly may be used, although on the Thames some good sport may be had with a dry fly in the summer among the dace. Avoid flics already tied to gut, as the fish can see the loops. The eyed flies, which are tied direct to the gut cast, are more quickly attached than the looped ones. I shall mention a very good knot for fixing these flies when I speak of knots for use in fishing. Of baits one cannot speak unless the kind of fishing is known. For bottom fishing, worms, paste, bread, gentles, and cheese, are used.

Gentles may be easily obtained in the summer by putting a piece of meat in the open where the blue-bottle flies can impregnate it with their eggs. These hatch out and very quickly produce the maggots. They can be purchased at almost any butcher's, whilst at Keighley in Yorkshire, there are several "maggot kings" who make a living from the production of these effective if somewhat offensive baits. Worms, especially the lobs, can be obtained on any lawn after a heavy shower, or can be dug up in the garden. Paste is made by mixing flour and water together until it forms a stiff dough. Bread is stale loaf soaked in water and then squeezed in a cloth until all the water is extracted. A little bran mixed with it, helps it to bind and remain longer on thc hook. Cheese is used just as it is, or pounded small and mixed in with the bread or

flour. It is a very effective bait for roach and chub.

Spinning baits are without number, and no *one* is better than another. They are generally expensive, but one or two good ones can be made at home. Of these I shall speak later, showing how they can be made from any old tin, spoon, or piece of motor inner tube.

Leads, other than the split shot used for bottom fishing, are necessary and expensive, but here again I will show you how to make them cheaply.

Floats can be made from either wood, cork, or quills, and are so well known that a description is hardly necessary. One of the best is the quill, and which can be manufactured from the wing feather of a swan or goose. The feather portion is stripped off, and cleaned up by running a lighted match down it. The quill is then cut at the feather end until of the desired length, split for an inch, and one of the halves removed. A brass ring is next slipped over the remaining split portion,which is turned up and over the ring, and afterwards bound securely with cobbler's waxed thread. The bottom portion may then be painted green, and the part which appears above the water, red. A rubber ring which may be made by cutting off a section of rubber acetylene gas tubing, such as is used on motor lamps, completes the float.

So much then for the necessary tackle. The fish which may be caught during the summer months include roach, perch, chub, bream, dace, rudd, tench, trout, and pike. Of these, roach, perch, dace, and pike are likely to provide the principal quarry.

Rudd and barbel are essentially river fish, and the same may be said of the coarse ungainly chub. Trout may also be caught in some of the free waters, notably the Thames, where they run to 6 lb.; as a matter of fact the smallest which may be taken in this river is 16 inches! Some trout! you say; well, you should see a 6-pounder.

Some sport may be had among the pike, although this fish is not really in condition until September or October. Previous to these months (it may be taken from June 16th in the Thames) it will be found to be very lean and flabby, for it is recuperating after spawning. The preponderance of weeds and rushes, where they have their hides and lairs, makes it very difficult to spin or live-bait for them. However, as in my opinion pike and perch are the only fresh water fish worth eating, with, of course, the exception of the trout—and there are not many of them in the free water—it is not a waste of time to try for either. Both pike and perch may be caught on an artificial spinner, and when you get a perch in this way, you can bet your bottom dollar that he'll be a big one. That's the beauty of spinning; you may get either pike or perch or both.

In the summer months, the pike haunt the reed beds some thirty yards from the banks. It is only during the winter when the river is swollen by flood, or in the spring, when they are spawning, that the big ones come in close to the bank. The little pike weighing from 1 to 2 lb. are close in, and will often make a grab and come struggling in at the end of your line. They are somewhat of a nuisance when paternostering for perch with the live minnow. This

method of fishing for perch, or the use of a lob worm on a paternoster is also deadly if there are any perch about; and where you find one, there are usually several others. With pike, if you get one, there may be *one* other near at hand, but not more. It is, therefore, not advisable to continue to fish one spot after taking out one or two pike.

Spinning in summer, either with the intention of catching pike or perch, must be done rapidly, or you will find your lure hung up in the weeds, and if your line is not a good one, it may stay there. You can always tell the bite of a pike from that of the perch. A pound perch has ten times the fight in him that a four pound pike will have. The pike gives a sullen tug, and on finding himself hooked, will immediately try to go to the bottom of the river. Here he will shake your line like a terrier does a rat, and then lie quiet again. In summer, after this, he allows himself to be drawn in without much trouble. If he should come to the surface and sit on his tail, at the same time glaring at you and shaking his open jaws vigorously, circumvent his intention of shaking out the hooks, by letting the line become slack at once. If you keep your line tight, he is almost certain either to break or shake out the hooks, for the pike does not appear to feel pain at all.

Now, with the perch, it is a different matter altogether. He sees your spinner passing, flips up his tail and goes after it, grabbing it manfully, for he is a generous biter. Then, feeling himself hooked, he determines to fight for his life. Off he goes, pulling the line after him, your rod point jerking

with his vigorous tugs. With fine tackle he will give you nearly as good a fight as a trout, and when landed is a sweet, firm fish if fried in his scales.

Barbel are usually caught with ledger tackle, and are a large gamely fighting fish. They are generally found in pools near weir streams, or in the channel of the river where the stream is not very heavy. If you use lob worms, gentles, or cheese paste, you may come across one. They rush up and down and across the river when hooked, and bore and plunge towards snags in their endeavour to smash up the tackle. Keep the rod well up, and only give line when you fear for the safety of your top-joint.

The chub is a river fish, but except for the sport of catching, they are a useless, coarse fish. They generally choose shady pieces of water under a bank, or clump of willows, and weir pools. They afford good sport with the fly, using a large Zulu, or Red Palmer, but they do not give much fight. On being hooked they make one mighty dive, which if your line is tight means losing the fish, and then come along like a lamb. Good baits for float use are cheese paste, boiled shrimps, live minnow, frog, cockroach, wasp, humble-bee, or almost any grub. In the cherry season, if a white-heart cherry is gently floated down, it will almost surely bag him. You can see chub from the peculiar manner they have of rising their top fins out of the water, and slowly sinking again. That clear unruffled patch under those willows, suddenly becomes broken water, as some six or seven fins rise above the surface. If you see them, don't at once rush up, rod in hand.

That will put them off the feed for the rest of the day. Crawl up within reach on your stomach, and gently float down a fly, or other bait. Then if one takes it, don't let him make a splash when drawing him in, or you'll have no more chub from that piece of water. He is most painfully shy, and the mere passage of a boat past him, will give his nerves such a shock, that he says "no thank you" to any tempting morsels which you may pass down for his benefit.

Good sport may be had among the dace with the fly, and when hooked he makes a very good show for his size. But a half-pound dace is considered quite a good fish; from which you will see that they do not run big. They are, moreover, frightfully bony, and only a boy with plenty of time would tackle one for his breakfast. Apart from the bones, it is a nice clean, sweet fish.

The Thames trout is *the* fish, if you can catch him, being as game as a salmon, and splendid on the table. He is mostly found near the weir pools (which are private fishing usually), but now and then he is taken in the main river itself. Spinning or live baiting with minnow, using light gut tackle, is the way to catch him. Then you can make up your mind that he's going to give you half an hour's fun, and in all probability break you before the end of that time. Up the river he'll rush for forty yards, and as suddenly turn. Then out of the water he'll leap, and if your line is tight, whoosh! he falls on it, and away he goes. May you have the luck to test your skill against his.

KNOTS FOR ANGLERS

THERE are numerous knots used in the tying of guts and lines, in order to produce a coupling which will not slip or come untied when subjected to the strains imposed upon them by the efforts of a fish in its death struggles. Perhaps the most useful for tying two pieces of gut together is that illustrated by A, B and C (Fig. 1). The ends of the gut, previously softened, are laid side by side, holding them with the left forefinger and thumb, so that the ends overlap at least half an inch. Then with the right hand form a loop of the two to the right, passing the ends through as at A, and again through as at B. Then take the ends in each hand and draw tight. The resulting knot will be seen in illustration C, and is the one found on all bought gut casts.

For joining lines or gut, the knot known as "The Fisherman's Knot" is one that will never slip and, moreover, is easily tied; quite the simplest of all knots, to my thinking. The method of tying it is as

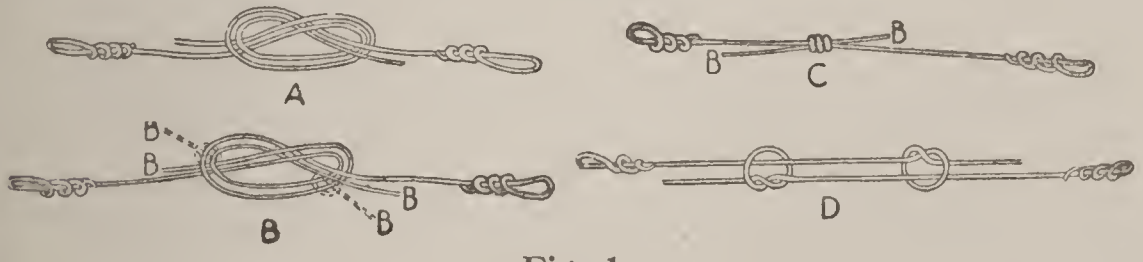


Fig. 1

follows: Take the two ends of the line and lay them with the ends pointing in opposite directions, i.e., one to the left and the other to the right. Then taking one of the ends, make a single granny knot

round the other line, and draw fairly tightly, but not enough to prevent its slipping. Do the same with the other loose end, only this time the granny knot is made on the other line. Then pull the two granny knots tight, and by pulling on each line, they will draw together and make a knot which for neatness and strength will take some beating. After pulling the knot quite tight, the ends may be slipped off closely. Fig. D shows method.

A loop which will not slip is useful to know, especially for those who use spinning baits. Fig. E shows first movement and F the knot loose, whilst G illus-

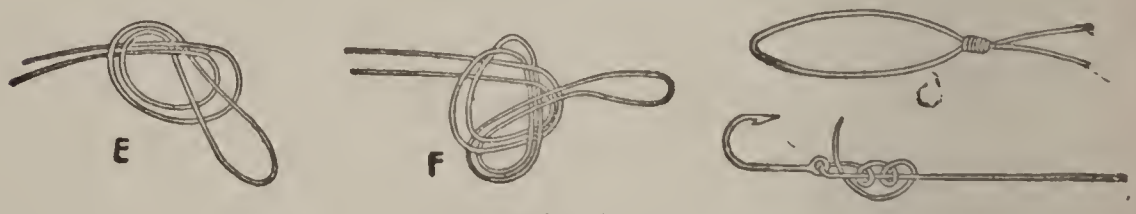


Fig. 2

trates the neatness and firmness of the loop. To make this loop-knot the line is turned over at one end for about 3 in. A large loose loop is now formed, but not tightened. The loop is then passed under, through, and over the middle aperture in the line. Then holding the end of the line, the finger is placed in the loop and drawn tight. It is one of the easiest knots to tie, and the loose end may be cut off close to the line without fear of drawing.

The tying of eyed fly hooks to gut is extremely simple. Fig. 2 shows the method. The eyed hook is taken in the left hand with the eye pointing to the right. Pass the end of the gut through the eye, allowing some 2 in. to project. Then twist the end twice round the main gut, and pass the loose end

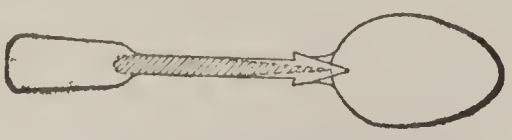


Fig. 3A.—Old Spoon for Spoon-bait

through the loop which will have formed near the hook. Then firmly holding the loose end, pull the main gut firmly, and the hook will be immovably fixed to the gut. The gut should, of course, have been soaked, and the end may be cut off close.

There is a certain satisfaction about the making of your own baits, apart from the saving in expense. When you catch a fish on one of them, you get a great deal more satisfaction than if the spinner had cost you several shillings; for has not the product of your hands baffled the brains of the fish?

Fig. 3.—Completed Spoon-bait

Probably the simplest to make is the spoon. Any old spoon will do for the purpose. It can be cut off from the handle by means of a hack saw, the bowl part being used for the bait. Do not throw the handle away, for it can be utilized to make a dead-bait spinner.

The spoon simply requires a $\frac{1}{16}$ in. hole drilled in each end, through which, at the broad end, is placed a small split ring, to which is attached a large pike triplet. Another split ring is put through the hole at the other end of the spoon, and a small swivel threaded on to the ring, and the bait is completed. It may be made more attractive if the inside of the bowl is painted with scarlet lake or other red paint.

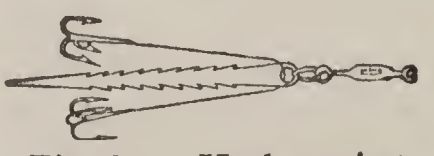


Fig. 3B.—Hack-sawing Spoon handle

To make a dead-bait spinner, place the handle of a tea-spoon in the vice and file it down on the flat

side until of the thickness of two postcards. Then place the flat side in the vice and file the handle part until it assumes a wedge shape measuring about three-sixteenths of an inch across. Now drill a hole in the handle end with the $\frac{1}{16}$ in. drill. Then file the sides of the thinned handle until they assume a saw-like edge, or it may be done with the hack saw. Attach the hooks as in the illustration Fig. 3B, insert a ring through the hole, to which attach a swivel, and you have a dead-bait spinner which will hold the bait for some time without breaking up. The tail hooks are inserted into the dead-bait in such a manner that a slight curve is given to the fish used. This causes it to spin when drawn through the water.

A most excellent and killing spinner may be made as in Fig. 4B from an old motor-car inner tube. Someone will give you a piece if you ask them. Six inches is quite sufficient. Sketch on the rubber in ink the outline of a fish and cut it out with a pair of scissors. It should measure about $3\frac{1}{2}$ in. for pike. Make two of these. Then from an old tobacco or other stout tin, cut also with a pair of scissors (tin can be cut quite easily by this means) the portion in Fig. 4, which will form the spinning flanges. Attach hooks on wire to the body part of spinning flange, turn over nose of spinner and solder down. Drill a $\frac{1}{16}$ in. hole through the head part of the spinner, attach ring and swivel, then sew on the two rubber sides of the bait. Paint the bait with some good aluminium or gold paint, on one side, and with scarlet or bright blue on the other, and you will have a most effective spinner at practically the cost of the hooks. It is quite as killing as, if not more so, than many of the

baits sold at 3s. 6d. to 5s. The fact that it does not look much like a fish in the hand, does not matter. It has the effect of a sprat or small daee when revol- ving in the water. Sprats are one of the best baits which can be used for trout and pike. They can be purchased for as low as 2d. a pound from November to February, and should then be pickled in a solution of 1 oz. of formalin to the pint of water. In this solution they will keep perfectly for at least twelve months, and become so hard that they can be handled without fear of breaking or tearing them. Their cheapness makes them an ideal boy's bait, apart from their killing nature. They may be used with a bait spinner, or on a flight of hooks, which causes the bait to roll and wabble in the water. I prefer the bait spinner, as this rolling motion sometimes causes the pike to miss his strike. Only recently I was using one on a spinning flight, and

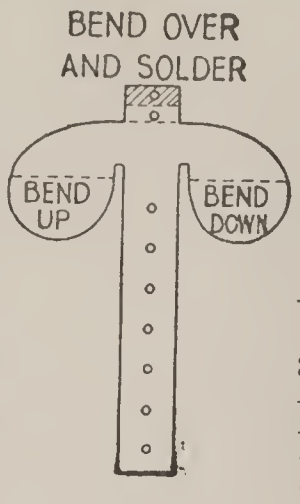


Fig. 4.—Tin Spinning Flanges

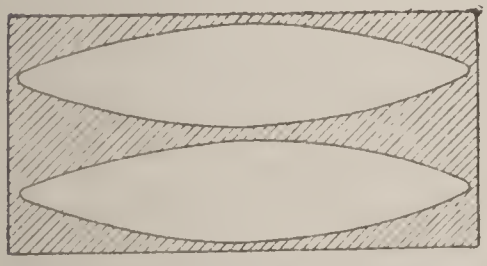


Fig. 4A.—Oblong of Rubbers

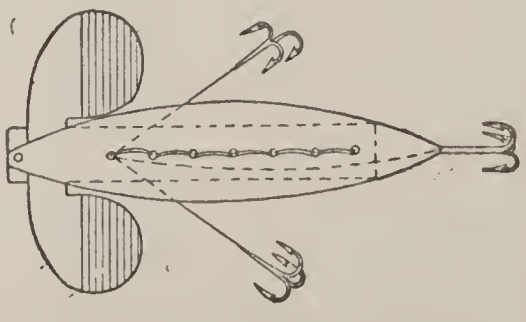


Fig. 4B.—Finished Bait

it was rolling most alluringly in a series of spirals. Then I saw a large pike dash madly at what he thought was a fish in distress, but the spiral motion beat him every time. Just as he was going to make

a grab, the bait twisted away in the opposite direction. I laughed at the antics which he performed in his endeavour to decide where the bait would spin to next. He followed that spinning sprat almost up to the edge of the river, twisting and turning in his endeavours to make a snap. Then, seeing me, I think he guessed that he had very nearly been "had."

The spoon is also a first-rate bait for pike, and if it must be purchased, has the advantage of being the cheapest artificial bait one can buy. The Wagtail, Cartman and Clipper are also excellent artificial baits, and are placed in order of cheapness, not merit; for the Wagtail is a splendid rubber bait. Once one learns to make the spinning flanges out of tin, the average boy will begin to devise fresh lures for himself. I make dozens every year, and try each one in the water, before discarding or retaining the pattern. Pike, however, if on the feed are not critical, and will take anything which moves in the water.

It seems rather a waste of cash to pay 4d. for a sinker or lead, but which one must have if it is required to spin a bait. There are all shapes and sizes of leads, but for all-round use, one weighing half-an-ounce, for sluggish water, and another of one ounce, will be sufficient for any boy. The heavier weight is, of course, intended for rapid streams, or when it is desired to keep the bait nearer the bottom. Their manufacture is simple. Some copper wire, an old tin, lead, and fine sand, are required. The sand is placed in an old cocoa tin until almost level with the top. It can be used dry, but is better slightly damp. A piece of copper wire is then severed of sufficient length, generally about

$2\frac{1}{2}$ in., and the ends turned up into loops. An old tin-lid may be used in which to melt the lead. The tin of sand is now taken, and a blunt-pointed pencil or tapering penholder is thrust into the middle of the sand to a depth of $1\frac{1}{2}$ in. When this is withdrawn there will be a thin hole or depression in the centre of the tin of sand. Using care, push the looped wire carefully down the middle of this hole, until it touches the sand at the bottom of the hole. This will hold the wire upright when the fingers are removed. Then melt the lead, and pour it into the hole containing the wire, until the lead comes level with the sand. Remove, trim up, paint green, and you have a 4d. lead (*See* Figs. 5, 5A and 5B).

At Pangbourne, near the weir pool, there is a little stream which runs into the Thames, named the Pang. About twenty yards up this stream is a little brick bridge, under which the big Thames trout love to stay.

If you go down there any evening, you will see a boy sitting patiently on the bank just above the bridge, "exercising"—as he calls it—a minnow on the end of about fifteen yards of fine line. Sometimes, if the big trout is at home, he manages to induce him to sample the bait, and a regular battle ensues. All the loafers in the neighbourhood seem to scent the conflict from afar, like vultures in the desert, and watch the struggle with interest. At other times the boy's patience is tried to the limit of endurance, for under the bridge he can hear the heavy "flop" which his intended victim makes, as he takes every other minnow in the stream but the one attached to his three yards of gut.

Last winter there was a lecture in the village on fishing. I took him. He stood the scientific descriptions of the different fishes, their history, past, present and future, for some time. But when the lecturer commenced with latin names for the fishes, and called the pike "*esox lucius*," he whispered in a voice which could be heard all over the hall: "Well, I thought this was to be a lecture on *fishing!*" I hope I haven't bored you like that; and perhaps I may have given you a hint or two which will enable you to have heavier bags during the coming season.

Fig. 5.—Lead and Wire after moulding

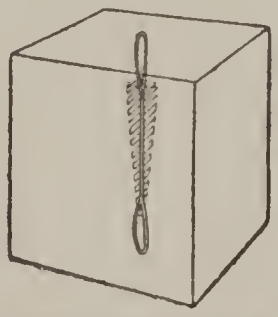


Fig. 5B.—Box of Sand

Fig. 5A. — Showing how wire is bent into loops

Section III

SCIENCE AS A HOBBY

CHEMICAL EXPERIMENTS

I.—THE AIR

BEFORE we study the chemistry of the air we may as well learn what we can, by simple experiments, of its physical properties. Everything we do, with the objeet of finding out something, is an experiment, and the only way in which an experiment can be of any value is when its result is noted. From the very start of your experiments you should make a habit of writing down your experience :

(*a*) Why the experiment was carried out.

(*b*) What was done. Be very exact in this.

(*c*) The result. In other words, what happened.

(*d*) Your deductions, or what you learned.

Simple observation has told you that there is an invisible something surrounding us on every side as we walk about the earth. We can feel its pressure as we run or cycle. We can see trees and leaves and smoke moving because of the pressure of this " something " when it is in motion. We cannot see it ; but we can prove that it is there.

Experiment 1.—*To prove that there is something which we call " air."*

This is the simplest experiment that you will perform. Turn an ordinary glass tumbler upside down and press it under the surface of water

contained, if possible, in a glass jar. You will see at onee that the water is prevented from entering the tumbler. If you make an exact observation you will notice that the water does enter a little way, but not very far. If you think about this you will arrive at the eonclusion that there must be something in the tumbler which resists the water and prevents it from filling the tumbler. The fact that the water does enter a little way suggests that whatever is in the tumbler can be squeezed up or compressed.

You have now performed an experiment and arrived at a conclusion. You are not quite satisfied. There may be some other reason why the water does not enter the tumbler. Very well then. Press the tumbler right down under the water, taking care to keep it straight. Now tilt it slightly. Immediately a bubble of something—we will call it air—rushes from the tumbler and aseends to the surfaee of the water, from whieh it eseapes. There is now some water in the tumbler, and we ean go on tilting the tumbler and allowing the air to bubble out until there is no more left and the tumbler is full of water. These two experiments together should be enough to convince you that there was something in the tumbler which we call air. As we did not put it there it must have come from the atmosphere which surrounds us. A second deduction, arrived at because we saw that air allowed water to rise in the tumbler, is that air can be eompressed.

We have given some time to this very simple experiment, because the method of performing it carefully and even more carefully noting the result is the basis of all chemical and physical experimental

work. You must learn, even when you are only doing ehemistry to amuse yourself, to perform eaeh experiment earefully, see what is happening or what has happened, and draw the proper eonelusion. It is by means of these simple things that the very greatest discoveries in the world have been made.

Experiment 2.—*What happens if we heat "air"?*

One of the first things which the old ehemists did when they had a substanee about which they knew nothing was to heat it and find out what happened. This is a very useful and interesting thing to do, and we cannot do better than follow their example. If we put the end of an "empty" test tube in the flame of our gas or spirit burner we quiekly arrive at the eonelusion that we ean see no change of any kind taking plaee. An ordinary careless, non-scientifie person might easily eome to the eonelusion that nothing at all was happening; but we are scientists, and we want to know. We must devise a more eareful experiment.

Fit a cork and a bent glass tube to one of your flasks and allow the end of the tube to dip under water as shown in Fig. 1. If you now apply heat to the flask you will soon see that bubbles are rising from the end of the tube. If you now remove the source of heat, water will start to run up the tube, and if you are not eareful it may run over into the hot flask and break it.

Something has happened to the air in the flask. The fact that water rushes up the tube direetly the heat is removed from the flask suggests that some of the air has been driven out and that the water is

taking its place. Since nothing could have got into the flask except the heat transferred through the glass, we conclude that the heat has made the air grow bigger and thus forced some of it out. We know some has come out, because we saw the bubbles. This is, in fact, what has happened, and we arrive at the conclusion that air expands when it is heated and contracts when it is cooled. It must have contracted, or the water would not have run up the tube.

But was it air that came out of the end of the tube? Do the experiment over again, but before you cork up the flask see if a lighted taper will burn inside it. It will for a short time, and as we know that a taper will burn in the air we can conclude that there is air in the flask. Now apply heat as before. Fill a beaker or a glass jar with water and hold it under the surface of the water so that the bubbles from the end of the tube will rise inside it and displace the water. A test tube will do for this. When all the water has been driven out, see if a taper or match will burn inside the jar or test tube. You will find that it will. You can conclude from this that there has been no chemical change in the air, but only a physical one.

Experiment 3.—Of what is air made?

When I tell you that air is mainly a mixture of two gases called oxygen and nitrogen, you will, I hope, believe me. But, being of a scientific turn of mind, you will want to find out for yourself. If you had to set about it unaided you would probably take a very long time before you arrived at any conclusion at all; but clever men a long time ago have

found out all about it and shown us the way. so that we can proceed without waste of time.

For this experiment you will want a bell-jar. This you can make for yourself by cracking the bottom off a glass jar for which you have a well-fitting cork. File a clean cut all round the bottom of the jar, and then touch the glass all round under the cut with a red-hot poker. The bottom should crack off cleanly. Smooth the rough edges with the file and you now have a bell-jar to add to your apparatus. You will find it of use to you for many experiments besides this one.

Half fill a soup-plate with water and float on it one of your evaporating dishes. Take a small piece of phosphorus. A piece about $\frac{1}{4}$ in. square will be enough unless your bell-jar is a big one. Place the phosphorus in the evaporating dish and cover it with the bell-jar, so that the bottom is sealed by the water. Have ready a jug of water. Now take out the cork from the top of the jar. This cork should have been prepared with a handle, as I described in my first article. Set the phosphorus on fire by touching it with a red-hot wire, and immediately replace the cork.

Now watch what happens. Dense white fumes begin to fill the jar from the burning phosphorus. The water is driven down a little because the air is expanded by the heat of combustion. Then it begins to rise. Presently the phosphorus will go out. Allow the jar to cool and then roughly measure the distance to which the water has risen. You will find out that it fills about one-fifth of the jar. (The jug of water you had ready was to add to the water

in the soup-place, because it will probably be all sucked up into the jar, and you don't want to have the experiment spoiled by allowing air to be sucked in.)

Now you can form your first conclusion. Something has been taken out of the air which formed about one-fifth of it. Obviously the burning phosphorus has taken it out. Probably it has gone to form the white fumes which we saw. I can tell you that it has, but you are not yet in a position to prove it for yourself.

Now take out the cork from your bell-jar and plunge a lighted taper into the jar. Immediately it goes out. From this you will conclude that the burning phosphorus has taken from the air the portion of it that allows things to burn or, in scientific language, "supports combustion." This is what has happened. The combustion supporting gas is called oxygen, and forms about one-fifth of the air. The part which will not allow things to burn is called nitrogen, and forms about four-fifths of the air.

Fresh apparatus or chemicals required: You will want no new apparatus, but you should now provide yourself with a book of blue litmus paper and a book of red litmus paper. These cost 2d. or 3d. each, and are just specially prepared paper which has been soaked in litmus solution and dried. They are used for telling whether substances have acid or alkaline properties.

Experiment 4.—This is, in some ways, a repetition of experiment 3. In your bell-jar, which must this time be standing on a dry surface, burn another small

piece of phosphorus. You will notice that the dense white fumes that are given off will gradually collect on the sides of the jar and on the plate or glass surface on which it is standing. When the fumes have all cleared, remove the bell-jar and examine this white "soot." You will find that it is a solid. If a little of it is put into a test tube and a little water added, the white solid will dissolve in the water. Put a corner of one of your strips of blue litmus paper in this solution. The litmus will turn red. This proves that the white substance has *acid properties*. It is not an acid, for an acid contains another substance called hydrogen.

Now for our conclusions from this experiment. From the previous experiment we have gathered that the burning phosphorus removes the oxygen from the air. Now we are forced to the belief that the oxgyen gas and the solid phosphorus combine to form an entirely new white substance. This substance is an oxide of phosphorus. Its chemical formula is P_2O_5, which means that two parts of phosphorus have combined with five parts of oxygen to form this entirely new substance.

Oxygen will combine with other substances to form *oxides*.

Experiment 5.—To prepare oxygen.

It is evident that this oxygen gas that forms part of the atmosphere is a very interesting substance, and it will be well worth our while to find out something more about it. To do this we must prepare a quantity of the gas, which is, fortunately, an easy thing to do. All we have to do is to heat a mixture of chlorate of potash and manganese dioxide. Both

of these substances contain oxygen, and we can set free the oxygen by heating either alone. The reason for mixing them is that the gas will come off at a much lower temperature from the mixture.

The apparatus is easy to get ready. We will require the flask and cork and bent tube which we used in Experiment 2. In addition we must have some glass jars—narrow-mouthed jam jars will serve very well—in which to collect the gas. The gas will have to be collected over water, and so we must fix up what is known as a *pneumatic trough*. This can easily be made at home. Fig. 1 will give you the idea. You will want an ordinary flower-pot with a base sufficiently wide to take the mouths of your glass jars. Knock a hole out of the rim of the pot and smooth it with a file. Stand this rim down in the bottom of a vessel sufficiently deep to allow water to well cover the flower-pot, which we have converted into a "beehive shelf." Now arrange your apparatus as shown in the figure. Put about an ounce of the mixture in the bottom of the flask and apply a gentle heat.

Very soon bubbles will be seen rising from the end of the tube which is dipped beneath the water. These are air which is being driven out of the flask. Let them bubble for about a minute, and then slide one of your glass jars, which you have previously filled absolutely full of water, upside down on to the beehive shelf. The gas, which is oxygen, will bubble through the hole in the beehive and gradually force the water out of the jar. When it is filled remove it and stand it in a saucer, in the bottom of which is a little water. Replace it on the beehive shelf by

another jar filled with water. In this way you will be able to prepare several jars of oxygen.

Experiment 6.—*Oxygen is a good supporter of combustion.*

Have ready a piece of copper wire to which is attached a piece of charcoal. Turn one of your jars of oxygen mouth up, and having induced the charcoal to glow by holding it in a flame, plunge it into the jar. Immediately it will begin to glow and burn very brightly, throwing off brilliant sparks.

Obviously something has happened to quicken up the rate of burning of the charcoal, which will only glow dully in air. We conclude that oxygen, which is a colourless, invisible gas, is a very good supporter of combustion.

When the brilliant burning has died down we can put another piece of glowing charcoal in the jar, but it will only glow dully. The first piece has taken up all the oxygen.

Though you cannot prove it for the moment, what has happened is that the carbon (charcoal) and the oxygen have combined to form carbonic acid gas. In other words the carbon has been oxidized.

Experiment 7.—Other substances besides charcoal will burn in oxygen with great brilliance.

Fasten the lid of a small tin to a piece of wire, so as to make a "deflagrating spoon." Put on it a small quantity of sulphur and set it on fire. It burns with a pale blue flame and makes a strong smell. Now plunge it into a jar of oxygen. It immediately begins to burn much more strongly and gives off dense fumes. As soon as the combustion is finished remove the deflagrating spoon, pour a

little water into the jar and shake it well, having first eorked or eovered it. Now apply a pieee of your blue litmus paper to the water. It turns red.

It is evident that by burning sulphur in oxygen we have eaused another aeid substance to be formed. This is sulphurous aeid gas.

Experiment 8.—If you are curious you may repeat your experiment with the burning phosphorus in a jar of oxygen. You will notiee that the eombustion is mueh more rapid, but that the dense white fumes and the white solid are formed just as they were when phosphorus was burned in air. The only differenee you will notiee is that they will be formed mueh more quiekly.

From this you will conelude that it really was oxygen that the phosphorus took from the air when burned in it, sinee the same results are obtained by burning phosphorus in pure oxygen. A solution of the white substanee will turn blue litmus red in just the same manner. You may note that the fumes smell just the same, though it is not wise to inhale the fumes of oxide of phosphorus to any great extent.

Experiment 9.—*Iron will burn in oxygen.*

A sensational ending to this series of experiments may be had by burning a pieee of iron in one of your jars full of oxygen. This is useful as showing that oxygen has a great affinity for even a hard and tough substance like iron, and will readily eombine with it.

To sueeessfully perform this experiment you need a length of fine iron or steel wire. An old hair-spring from a watch or cloek will do very well.

First heat this in the strongest flame you have to hand to prove to your satisfaction that it will not burn in air.

Then, having a full jar of oxygen ready, dip the warmed end of your wire in some powdered sulphur, so that a little adheres. Set light to this sulphur and plunge it immediately into the oxygen. The sulphur will first flame brilliantly, heating the wire to redness. Then the metal itself should begin to burn, throwing off brilliant sparks until either the metal or the oxygen is consumed.

We conclude from this experiment that iron will combine with oxygen as readily as either sulphur or phosphorus or charcoal. From the knowledge we have gained we would suppose that the result would be the formation of a new substance entirely different from either iron or oxygen. In fancy we would expect to find, in some form or other, an oxide of iron remaining in the jar. We shall not be disappointed. Examination will show us many small flakes of a black solid substance. This is an oxide of iron. It is commonly called black oxide of iron.

We have found out that iron or steel, which will not burn in air, which is very diluted oxygen, will burn in pure oxygen.

Now, before you have done thinking about the affinity of iron for oxygen, go out into the garden and look at a nail that has been in the wall or fence for some time. It is red with rust. This rust is another oxide of iron, formed by the action of the oxygen of the air on the iron in the presence of moisture.

II.—WONDERFUL HYDROGEN GAS

Hydrogen (H) is the most wonderful of all the elements, and one of the most abundant to be found on the earth. As we know it is found in water, in which it forms a chemical compound with oxygen, another wonderful element. It also goes to form coal, the oils and spirits, like lamp oil and petrol, the dyes that give the colour to all the fabrics we use for our clothes and about our houses, the bread and sugar we eat, and hundreds of other substances in daily use. In most of these things it is in combination with oxygen and one or two other elements, of which the most usual is carbon. It is an essential part of all acids.

Hydrogen is the lightest of all known substances. Equal volumes of hydrogen and air have been weighed, and it has been found that Hydrogen weighs only one-fifteenth as much as air. One of the most curious things about hydrogen is that chemists have not yet quite made up their minds whether it is a metal or a non-metal. True you will generally find it placed with the non-metals in your school chemistry books; but that is because it always used to be placed there, and it does not seem right to change it until the clever men who are always investigating these matters are quite sure.

Because hydrogen is so important and because it is one of the two elements that go to form water we will now do some experiments with it.

Experiment 1.—*The preparation of hydrogen gas.*

We have said that hydrogen is an essential of all acids. Luckily it is quite easy to get an acid to give

up its hydrogen, so that we can collect it and examine its properties. To do this experiment fit up a bottle or flask with a tight fitting cork in which you have bored two holes. One of these holes is for a thistle funnel or tube, made as described in the article on glass-blowing, and the other for a delivery tube. The thistle-tube must pass to the very bottom of the flask.

In the bottom of the flask place some granulated zinc, or zinc clippings—about an egg-cupful will be quite enough. Now put in your cork, with the tubes in place, and pour in enough dilute sulphuric acid to fill about a quarter of the flask. Immediately the mixture of the acid and water touches the metal zinc you will see bubbles form and disengage themselves. Very soon bubbling becomes very active.

Of course you don't know what these bubbles are, and if this was the very first time this experiment had been done you would have to go to a lot of trouble to find out. As a matter of fact you can take my word for it that the bubbles consist of hydrogen gas.

But why has the hydrogen formed? It is very simple. The sulphur and oxygen in the sulphuric acid *like* the zinc (they have an affinity for it, in scientific language), and the hydrogen does not like it at all. As a matter of fact the sulphur and oxygen like the zinc better then they like the hydrogen. They leave the hydrogen by itself and combine with the zinc to form another compound which is called sulphate of zinc. The hydrogen having now nothing to bind it goes off on its own.

The hydrogen gas, once it has driven the air out

of the flask will issue from the delivery pipe. Now for a strong word of warning. Hydrogen takes fire very readily and forms with air a very explosive mixture. Don't do this experiment anywhere near a naked flame or you may have an explosion that will burst your flask and may damage you.

You can collect the hydrogen over water as has been explained in the article telling you how to make oxygen, or you can collect it simply by holding a gas-jar over the end of the delivery pipe. The former is the safer way as you are then sure of getting pure hydrogen. Collect several jars of the gas, and then you can examine it. You will have already noticed that it is invisible. Pure hydrogen is without odour; but that you make will most likely have a slightly disagreeable smell owing to the presence of slight impurities which are compounds of hydrogen with sulphur, arsenic and carbon, all of which very likely exist, in minute quantities in your chemicals.

Experiment 2.—Hydrogen is a very light gas.

To find out if it is really true that hydrogen is very light you can perform a very striking experiment and one that always looks effective if it is done at a demonstration. You must make a rough balance out of a rod of wood or steel. If you have a balance it will, of course, serve for this experiment. Weight one side so that it correctly balances a light glass bell that hangs from the other arm. Part of a broken flask or a small beaker will do for this. It is hung with its mouth downward, and of course it is filled with air. Now take one of your jars of hydrogen and pour the gas from it *upwards* into your balanced bell. The other side of the balance will go down

as the light hydrogen pours into the bell and displaces the air. The gas is so light that it tries to rise and actually forces the bell upwards. It is this lightness of hydrogen that makes it so useful for filling balloons. All our airships are filled with hydrogen.

Experiment 3.—*Hydrogen burns readily in air.*

Hold one of your bottles full of hydrogen upside down and place a lighted taper to the mouth. The hydrogen takes fire with a slight report, and then burns quietly with a beautiful pale blue flame. Now use your eyes. When the flame has gone out do you notice anything curious about the jar ? Very little observation will show you that it is covered on the inside with a film of moisture. This moisture is actually water. The hydrogen has combined with the oxygen of the air to form water, the chemical formula for which is H_2O, meaning that two parts of hydrogen have combined with one part of oxygen.

Experiment 4.—*Another way of proving that hydrogen is very light.*

Prepare some soap solution as for blowing bubbles. A small quantity of glycerine added to the solution will make it work better. Now connect an ordinary clay pipe to the end of your hydrogen delivery pipe by a three or four feet length of rubber tubing. Dip the bowl of the pipe into the solution, just as you do in blowing ordinary bubbles, and let the gas blow a bubble. To do this you must have the gas coming off strongly. You will find that bubbles so formed will rise rapidly through the air. If a lighted taper is applied to these hydrogen bubbles they will burst into flame. If you are clever with your fingers it is possible for you to make a small balloon of gold-

beater's skin that will serve to demonstrate the lightness of hydrogen any number of times. It is not possible to fill a rubber balloon with the gas unless you have some means of forcing it in against the resistance of the rubber.

Experiment 5.—Pass a lighted taper into one of your filled jars of hydrogen. You will notice that though the gas is set alight at the mouth of the jar the taper goes out. Having observed this and performed the experiment two or three times you will draw the conclusion that though hydrogen will burn very readily in air it will not support combustion. If you care to make the experiment, however, you will find out that it is possible to light a jet of oxygen gas in hydrogen. The result of this flame of oxygen burning in hydrogen is the formation of water. It is also possible to get a jet of chlorine to burn in hydrogen. Both these experiments are rather tricky for the beginner, and the latter is distinctly dangerous for hydrogen and chlorine combine so readily that a strong light falling on a mixture of hydrogen and chlorine is sufficient to cause them to explode.

We have now investigated some of the chief characteristics of hydrogen, which, together with oxygen, makes that ordinary substance water. In our next series of experiments we will return to the consideration of water.

III.—THE CHEMISTRY OF WATER

You must never forget that experiments are performed for a definite purpose. That purpose is always to find out something. It may be

to discover how a substance behaves in certain circumstances, it may be to find out of what a substance is made, or, if you know the components of your substance, it may be to learn exactly in what proportion elements are combined to form whatever it is you are investigating.

These latter experiments are the most difficult that any chemist is called upon to perform, for they demand accurate measurement and very careful work to ensure that no errors shall creep in. You will have to do such work sometime or other, if you are going very far with chemistry, and so you may as well start them early in your career. We will start with an analysis of water.

Experiment 1.—*The composition of water by weight.*

This experiment is really very simple to carry out. The difficulty is in the accurate weighing. Unless you have a very accurate balance all that you will be able to do is to make a rough estimate of your weights and reserve accurate weighing until some time when you can get the use of a chemist's balance. To do the experiment in a rough and ready manner a photographer's balance is quite sufficient.

Procure a short length of iron or steel pipe—nine or ten inches will be quite sufficient—and place in it a small quantity of iron turnings or filings. Weigh the tube, with filings in place, and make a careful note of the weight in your notebook. Next half fill a flask with water and weigh that also. Note the weight.

Now connect your apparatus up so that the flask is connected, by glass and rubber tubing, to one end of the iron tube. To the other end of the iron tube

you can affix a delivery tube so that you can collect the hydrogen gas that passes off.

You must next make some provision for strongly heating the iron tube so that the filings inside it may be made red hot. This can be done with a gas-ring, a primus-stove, a blow-lamp, or by any other means that will give a really good heat. When I was a boy I did this very experiment by means of a home-made charcoal furnace that I manufactured out of an old biscuit tin. It acted finely, but it developed so much heat that it burnt the old table I used as a laboratory bench. I forget how I made it, but you can easily think it out for yourselves if you want to make one. It was something like those "fire-buckets" that watchmen on road-mending jobs use in the night. There was a hole right through from side to side to take the iron tube, which was quite surrounded by glowing charcoal.

But you will be wanting to be getting on with the experiment. Having seen that your tube is in a fair way to becoming red hot you can begin to heat up the water in the flask. This must boil strongly, so that it will give off steam in a good stream. To do the experiment accurately the steam should not start to pass from the flask until the tube is glowing, or rather until the iron filings inside it are glowing.

The steam passes through the red hot tube, and a gas comes out at the other end. If you collect this gas you will find that you can test it in just the way that you tested hydrogen in our last series of experiments, and that it will act in exactly the

same way. It is, in fact, hydrogen gas that you have prepared.

But steam went into the tube and hydrogen has come out! What has happened? It is very simple. Iron, particularly red-hot iron, has a very strong affinity for oxygen. It gathers up all the oxygen from the steam, which is only water in the form of gas, and sets the hydrogen free. The oxygen combines with the iron to form "black oxide of iron."

Weigh your iron pipe, and also your flask. You will find that the iron pipe is heavier than it was when you started the experiment. That gain in weight represents the oxygen that has been taken from the water vapour. The flask weighs less, because of the steam that has passed off.

I expect that it is about as far as you will be able to get; but, if you are sure that you have produced hydrogen and you are quite sure that your tube weighs more, and if, on opening the tube when it is cool, you find much of the iron filings turned into a black, powdery substance quite unlike iron, then you will have done very well for a start.

If you have sufficiently delicate apparatus to weigh everything carefully you will arrive at some very interesting conclusions. We will suppose that there were, in the tube, 168 grains of iron. If you have so conducted your experiment that all this iron is turned into black oxide, you will now find the weight to be 232 grains, a gain of 64 grains This represents the amount of oxygen taken from the water vapour. If you now weigh the hydrogen you have collected it should weigh exactly 8 grains.

This represents the decomposition of 72 grains of steam. Even when you are working very carefully you will be sure to find that you have lost more than 72 grains when re-weighing your bottle that you used to boil the water. It is very difficult indeed to use exactly the right amount of steam.

If you divide the figures we have used by four you will see that 2 grains of hydrogen are produced from 18 grains of water, leaving 16 grains of hydrogen to combine with 42 grains of iron.

The chemical formula for water is H_2O and means that water consists of 2 atoms of hydrogen and 1 atom of oxygen in each molecule. Remember those names and look at the weights again. Eighteen grains of water give 2 grains of hydrogen, and 16 grains of oxygen. What do you deduce? A little thought will suggest the fact that one atom of oxygen weighs 16 times as much as one atom of hydrogen. You have determined the composition of water by weight. Eighteen parts of water will contain 2 parts of hydrogen and 16 parts of oxygen—by weight.

Experiment 2.—The composition of water by volume.

To perform this experiment satisfactorily you must have a fairly strong battery, though you can perform it with a single cell from an electric torch if you are prepared to be very patient and wait a long, long time, several days, for your results. If you can get the use of six or eight cells such as are used for electric bells, or, better still, a strong secondary battery (accumulator) such as is used by motorists for their lighting sets, you will be able

to perform your experiment quickly and see it in operation.

The apparatus is simple, apart from the battery ; but it must be carefully prepared. The idea is that if a current of electricity is passed through water it breaks the water up into its two gases. What we have to devise is some means of collecting these two gases and testing them to find out what they are. We also want to measure them.

The best thing to use is the bottom, or holder, portion of a spent electric light globe. This will be found to have two pieces of wire projecting through the glass. To the brass connecting pieces on the holder solder or otherwise strongly attach two lengths of stout electric bell wire, taking care that you do not make any electric connection between the two brasses. When the connections are made cover them all over with sealing wax or candle wax so that it is impossible that any portion of the metal of the holder that was outside the bulb is exposed to the water when you sink your apparatus in a bowl. The current must pass through the water through those two pieces of wire that held the filament when the lamp was unbroken.

Now sink your holder in water to which you have added a drop or two of sulphuric acid—this is only to quicken the action. See that it sits on the bottom of the bowl so that the holder portion is at the bottom. Now fill the two test-tubes with water and arrange one over one terminal and the other over the other. Connect up the free ends of your wire to the terminals of your battery. Bubbles of gas will collect round each of the terminals and will rise into the tube

placed over them. You will soon see that gas is collecting in one tube exactly twice as fast as in the other. When you test these gases, according to the experiments you have already performed, you will find that the one that collects twice as fast as the other is hydrogen. The other is oxygen. Now remember the formula for water—H_2O. In water there are two atoms of hydrogen for every one atom of oxygen.

We have now learned two important things about water and about the gases that combine to form it. One is that if we measure the gases by weight we find there is eight times as much oxygen as there is hydrogen. If we measure by volume we find that there is twice as much hydrogen as there is oxygen. Hydrogen is the unit (1) of weight for atoms. The oxygen atom weighs sixteen times as much.

IV.—CARBON

One of the important elements which is in very many of the things we see around us and use in our daily life is carbon (C). It is in chemical combination with other elements in very many things and it is found in a pure, or nearly pure, form, in several varieties.

The diamond is pure carbon, so is graphite, or "blacklead" from which pencils are made. Lampblack, which is really soot, is pure carbon, and charcoal, prepared by strongly heating either animal or vegetable substances, is nearly pure carbon.

It is difficult to believe that the bright and sparkling diamond, the most valuable of gems,

and ordinary soot, of the lead of your pencil, are one and the same element; but so it is. If you don't believe it you can easily prove it. You only have to burn a diamond in oxygen and then, in another jar of oxygen burn a piece of graphite or charcoal. On applying the same test to the gases which remain in the jars after the diamond and the other varieties of carbon have been burnt we get the same result. Don't laugh at the thought of burning so valuable a thing as a diamond. It has been done.

The sure test for carbon when it has been burnt in air or oxygen is by agitating some of the resulting gas with "lime water." The lime-water turns milky. When diamond is burnt in oxygen and a little lime-water is shaken up in the jar afterwards the lime-water turns milky. The same thing happens when the test is repeated after graphite or charcoal or lamp-black have been burnt. There is only one thing that will turn lime-water milky, and that is carbon-dioxide gas, commonly known as carbonic acid gas.

Experiment 1.—*To prepare lime-water.*

You will find it useful to have a bottle of lime-water in your laboratory, and since you can easily prepare it yourself there is no reason why you should not add it to your stock of chemicals. You will have acted on my suggestion and prepared some distilled water. Place some of this in a flask or beaker and then beg from the nearest place where building operations are going on, a piece of lime, either slaked or unslaked, about as big as an egg-cup. Put this in the water. You have enough

lime to make a gallon of lime-water, so that you can make a good quantity. Stir up well and let the solution rest for several hours. Pour off the clear water and you have your lime-water. The sediment that remains is of no value, and may be thrown away.

Lime is the common name for Oxide of Calcium, calcium being a yellowish metal (an element) that combines so readily with oxygen that it is seldom found in a pure state. Lime water is simply a solution of hydrate of lime in water. By the way don't attempt to hurry the making of your lime-water by trying to mix it in hot water. Hydrate of lime (slaked lime) is about twice as soluble in cold as in hot water.

Experiment 2.—Place a little lime-water in a tumbler or beaker and blow in it strongly through a glass tube. Very soon you will see the clear lime-water turn milky. A little while after, if you continue blowing, the water will clear again.

The explanation of this is quite simple. The carbonic acid gas in your expired breath combines with the lime in the water to form calcium carbonate, or chalk as it is more commonly called. This formation of chalk from lime-water is a sure test for the presence of carbonic acid gas, and it is by this test that the diamond has been proved to be exactly the same elemental substance as charcoal, as has already been told. The reason why the lime-water clears again is that the water takes some of the carbonic acid gas into solution, and chalk is soluble in water containing carbonic acid gas, forming *bi*carbonate of lime.

Experiment 3.—*Wood contains carbon.*

Place some chips and shavings of wood in a test-tube and fit a cork and glass tube to the test-tube. If the test-tube is now strongly heated gas will be driven off through the delivery tube. This at first consists of steam, until the wood is thoroughly dry. Afterwards various inflammable vapours will come off and may be lighted at the jet. Round the cooler end of the test tube and in the delivery tube a kind of tar will form. When inflammable gas no longer issues from the delivery tube the test-tube should be taken from the flame and allowed to cool. On opening it a mass of charcoal will be found inside. If you have weighed the original wood you will find that the charcoal is much lighter. Having seen all that vapour and tar driven off you will expect this. You can repeat this experiment with dried meat, with bread, sugar, starch, or any animal or vegetable substance. Test by burning a small portion in a closed vessel and then agitating the resulting gas with lime water. In every case it will turn milky, proving the presence of carbon dioxide, resulting from the combination of the oxygen of the air with carbon.

Experiment 4.—*The combustion of carbon.*

Fix up an apparatus consisting of a large diameter glass tube containing charcoal or some other easily burnt form of carbon.

The delivery pipe dips under lime-water. From the other end a slow current of oxygen or air from a football bladder or bellows can be passed through the tube. If the current is passed over the carbon in the tube it bubbles through the lime water without

affecting it in any way. Now if heat is applied so that the carbon begins to glow, the lime-water immediately takes the milky tinge that is characteristic of the passing of carbon dioxide. The inference is that the application of heat has allowed the oxygen to combine with the carbon, which it could not do when both were cold.

Experiment 5.—If you continue to heat the carbon in the tube arranged for the previous experiment until the substance ceases to burn you will find that there is nothing left but a small quantity of white ash. This is mineral matter. All the carbon has been taken away by the oxygen to form carbon dioxide, leaving the mineral matter behind. This mineral matter is an impurity mixed with the carbon. If the carbon had been absolutely pure, as it is in lampblack, no ash would have remained behind. Burning is always resorted to when it is desired to find out how much mineral matter there is in an organic substance. A weighed portion of the substance is heated until all the organic matter is consumed. The resultant mineral ash is weighed and the proportion found.

You cannot prove it for yourself; but you will be interested to know that carbon is almost the only, if not the one element which is known to exist only in the solid form. Oxygen, hydrogen, nitrogen, and the other gases may be liquefied and solidified. Sulphur, phosphorus, iodine, and the other non-metals can be turned into liquids and gases. Mercury we know both as a solid and a vapour as well as a liquid, and all the metals may be melted and vaporized. Carbon has never been melted. It is

impossible, also, to dissolve carbon in any known liquid. Charcoal gradually disappears when it is boiled with sulphuric and nitric acids, but it is not merely dissolved. It is converted into carbon dioxide.

V.—CARBON DIOXIDE—POISON GAS

Carbon dioxide, which is called carbonic acid gas, and is formed by the combination of one molecule of carbon with two molecules of oxygen to form one atom of carbon dioxide, is a very real poison gas. As you know we breathe in air into our lungs. The oxygen of the air combines with the carbon in our bodies to form the deadly CO_2. That is the reason why the air of cinema theatres and crowded halls is so bad to breathe. Carbon dioxide is a poison.

Experiment 1.—Blow through a glass tube into some lime water. The lime water soom becomes milky, proving that the air we breathe out of our lungs contains this gas.

Experiment 2.—Light a candle and place it under a glass gas-jar or any other glass that will prevent a new supply of air from reaching it. To make sure let the glass stand in half an inch of water. You will observe that the candle very soon dwindles and dies out. Why ? No more oxygen, you say. Very good ; but it is something more. If you pour a little of your lime-water into the jar and shake it about you will see that it turns milky. The candle, in burning, has somehow formed carbonic acid gas. As a matter of fact there is a great deal of carbon in the candle wax. This has been set free by the

burning, and has combined with the oxygen of the air.

Experiment 3.—*To make carbon dioxide.*

This gas can easily be made in several ways. The easiest is by allowing an acid to act on any of the carbonates. Ordinary washing soda is really carbonate of sodium. You have already been told that chalk is carbonate of calcium. Place an ounce of either of these substances in a bottle fitted with a thistle tube and delivery tube as shown in the sketch and pour dilute hydrochloric acid down the thistle tube. Carbonic acid gas will commence to bubble off and may be collected by downwards displacement, as it is much heavier than air. It will not do to try to collect it over water as we do oxygen and hydrogen and many other acids, for water will absorb a great deal of carbon dioxide. Ordinary soda water is simply water in which carbon dioxide has been dissolved under pressure. Directly the pressure is released—by removing the cork or stopper of the bottle—the gas bubbles out of the water.

Having prepared a quantity of the gas test some of it by shaking with lime-water. The lime-water will turn milky. The cause of this was explained in the last series of experiments.

Experiment 4.—*Carbon dioxide is heavier than air.*

This is simply a reversal of your experiment with hydrogen gas. Balance a beaker at one end of a scale beam, mouth upward. If you now pour a quantity of carbon dioxide into the beaker, just as though you were pouring water, the beaker will descend, proving that it is now heavier than when

it contained air. This is a most striking and mysterious experiment to watch. Carbon dioxide is invisible, and you can see nothing being poured into the beaker, and yet the beaker goes down as surely as though you had dropped a weight into it.

Experiment 5.—Plunge a lighted taper into a jar containing carbon dioxide. It at once goes out. Carbon dioxide will not support combustion.

Carbon dioxide is often produced in large quantities in nature, and sometimes collects in caves and at the bottom of valleys. In such cases men or animals going into the "lake" of gas unawares, are quickly stupefied and killed by the poisonous gas. As the gas is so heavy it frequently lies on the bottom of such "death caves" or death valleys, and a man can walk through them without knowing of any danger whilst a dog trotting at his heel is most mysteriously killed.

Experiment 6.—*Carbon dioxide is soluble in water.*

The young chemist will never let any statement pass without doing his best to test it, if the means to test it are within his reach. We have made two statements in this chapter which you should investigate now that you know how to do it. One is that ordinary soda water is simply ordinary water containing carbon dioxide in solution, and the other is that carbon dioxide is soluble in water. Let us test the latter statement first.

Fit up your apparatus for manufacturing carbon dioxide, but instead of collecting the gas as it comes off by downward displacement allow it to bubble through a bottle or flask containing water. Let it bubble for about ten minutes—longer if the water

is warm, for CO_2 dissolves more easily in cold water than in warm—and then shake up a little lime-water in the bottle or flask. The water will turn milky, proving that carbon dioxide is present. To be quite sure that it has come from the flask in which you have prepared it you should shake some of the water you are going to allow the gas to bubble through with lime-water before the experiment. You will find that it will remain clear. Use the rest of the water for your experiment. The conclusion you arrive at is that the water has dissolved and held in solution some of the gas.

Now pour out from a bottle or siphon a small quantity of soda water. Shake it up with a little lime-water as before and you at once get the characteristic milky appearance. Since you can quite easily prove that the gas which comes off in bubbles from the soda water will not ignite nor will it support combustion you are quite right if you conclude that it is carbon dioxide.

Experiment 7.—Carbon dioxide in solution is an acid.

We have already stated that a characteristic of an acid is that it contains hydrogen. You cannot prove this for yourself as yet, so you must believe it without proof until you are able to prove it. Meanwhile you can easily prove that a solution of carbon dioxide in water is a weak acid. By itself carbon dioxide cannot be an acid, for, as you know by the formula (CO_2) it contains no hydrogen. But water (H_2O) will supply the necessary hydrogen.

Bubble some of the carbon dioxide gas through a fresh supply of water and add to the solution a

solution of blue litmus, or place in it a piece of blue litmus paper. The litmus will slowly turn a pinky red. We know that litmus (blue) always turns red when touched by an acid, so we conclude that carbon dioxide in solution is a weak acid, since the reaction takes place but slowly.

Experiment 8.—*To make litmus solution.*

In your collection of chemicals and apparatus there should be some litmus solution both red and blue. The red solution will enable you to test if a substance is an alkali and the blue to test if it is an acid. We have already suggested that you should have a book of both coloured litmus paper, as such books may be purchased quite cheaply. But the real chemist always likes to prepare for himself everything he possibly can, and if you have growing in your garden any red (pickling) cabbage, you can make gallons of litmus solution for nothing. You won't need gallons though. A pint will last you a very long time.

Break up a leaf of the cabbage into small portions and place it in a crock. Pour on it boiling water pounding and rubbing the cabbage with a pestle or spatula as you do so. (A spoon will do to rub it with if you have nothing more convenient.) Allow the liquid to cool and you will find that it is of a fine purple colour. You can bottle it for use as it is if you like; but to make sure that it will keep you should add a little spirits of wine (ordinary methylated spirits will do quite well) to the solution.

This purple liquid is an ideal test solution. If on adding a little to another solution which you wish to test it turns more blue you know that the solution

contains an alkali. If it turns red you know that it contains an acid. The purple solution can be made definitely blue or red by adding to it small quantities of weak ammonia or weak acid.

VI.—COMMON SALT AND CHLORINE GAS

The common salt that is used in cooking in the kitchen and appears on our tables and is eaten with almost every meal, is a very interesting substance from a chemical point of view. It is also interesting in that it is the only "mineral" which we commonly and knowingly eat.

"Salt" is a chemical compound which is made up of the two elements sodium and chlorine. Sodium (Na) is a silver white metal which has so great an affinity for the elements contained in water that it has to be kept in a bottle under naphtha in the laboratory to prevent it from rusting away. It costs about three shillings an ounce. Chlorine is a yellowish green non-metallic gas. A compound of a metal and chlorine is called a chloride. Common salt is sodium chloride (NaCl). It is contained in large quantities in sea water, from which it may be obtained by evaporation. It occurs in big beds underground, where it has been deposited by the evaporation of salt water lakes and bays in far-off times.

When using "salt" for your experiments take care that it is ordinary salt and not the salt mixed with other substances that are sold under fancy names.

Experiment 1.—*The preparation of chlorine from common salt.*

Fix up a flask and delivery tube so that the gas may be collected over water as previously shown. Mix together thoroughly 1 ounce of common salt and 1 ounce of black oxide of manganese (manganese dioxide). Moisten the mixture thoroughly with dilute sulphuric acid in the proportions of 2 parts of water to 1 part of acid. Shake the mixture thoroughly together in the flask until all of it is wet with the acid and then place your delivery tubes, etc., in position. Now apply gentle heat to the bottom of the flask. Almost immediately a greenish-yellow gas will begin to come off in large quantities. This is chlorine gas. Take care not to breathe it, as it has a very irritating effect on the lungs and the delicate lining of the nose and mouth. Collect about six jars of the gas and cover or stopper each jar as soon as it is full, to prevent the gas escaping. Chlorine is heavier than air, and may be collected by downwards displacement of air; but by collecting it over cold water less gas escapes. Directly they are full the jars should be turned mouth upwards. Use warm water in your collecting trough, for the gas is less soluble in warm water than it is in cold.

You will want to know what happens in your flask when you apply the heat to make the gas come off, and you have no means of finding out. It is a very pretty example of ordinary chemical reaction. Sulphuric acid (H_2SO_4) is "hydrogen sulphate." The hydrogen combines with the oxygen of the manganese dioxide to form water. The manganese of the oxide and the sodium of the chloride combine with the "sulphate" portion of the acid to form sodium sulphate and manganese sulphate,

and the chlorine, having nothing to combine with, is set free.

Directly you have finished experimenting with a jar of chlorine put it out into the open air to allow the gas to escape.

Experiment 2.—Chlorine will support combustion.

Introduce a piece of lighted candle on the end of a bent wire into a jar of chlorine. The flame is not extinguished, but it burns feebly and with a pale flame, giving off great clouds of black smoke. This is explained by the fact that the wax of the candle contains the elements hydrogen and carbon. Hydrogen will burn in chlorine, but carbon will not. The carbon is set free in the form of soot. As the flame burns the chlorine combines with the hydrogen to form hydrochloric acid. As the experiment proceeds you may see some white fumes appear. These are the fumes of hydrochloric acid which show as the gas comes in contact with the air.

Experiment 3.—Chlorine and hydrogen combine spontaneously in the presence of sunlight.

This is a very effective experiment which always "comes off" if it is carefully prepared, and always interests those who are not very well up in chemistry, so that it is a good show experiment.

A soda water bottle or florence flask should be filled to the very brim with water. Now measure the water accurately and return exactly half of it to the flask or bottle. Mark the level by scratching on the glass with a diamond or file. Now fill the bottle full with water again and insert a short glass funnel in the mouth. Invert the bottle in the gas trough and bubble chlorine from one of your filled

jars into it by way of the funnel until the water has sunk to exactly the mark you have made. Displace the rest of the water by hydrogen from your hydrogen making apparatus, allowing the gas to bubble freely for some time, to drive out all air, before you let it go into the bottle. Care is necessary here to make sure that the experiment will not fail. Also you should do this part of the work where there is no chance of sunlight or very strong light falling on the flask.

Now cork your bottle and tie it to the end of a long stick. Shield your face and warn any spectators to do the same and then thrust the bottle out into the strong sunlight. Immediately there will be a loud explosion in the bottle, which may be shattered. If you want to show this experiment at night you will find that half an inch of magnesium ribbon burnt a yard away from the flask containing the mixture will usually cause it to explode. The gas resulting from the explosion is, of course, hydrochloric acid.

Experiment 4.—*Chlorine has a great affinity for metals.*

Another very effective experiment or series of experiments, consists in shaking powdered metals into jars containing chlorine. The best to use are very fine copper or brass filings and very finely powdered antimony. Place a little water in the bottom of your gas jar before you do these experiments to prevent the jar from being cracked by falling fragments of red hot metal.

When the copper or brass is shaken into the gas it burns with a brilliant reddish light, giving off yellow fumes and forming a green.

HOW TO MAKE COAL GAS

YOU can easily make a small quantity of coal gas for yourself and it is an interesting experiment to do, for it will help you to understand how gas is manufactured in the huge quantities required for lighting and heating our great cities.

An ordinary clay pipe will serve for your retort. Fill the bowl with coal dust and cover the top securely with stiff wet clay. Then put the bowl well into the glowing coals of a hot fire, with the stem projecting through the bars. You now have exactly the same conditions in which gas is made. Your coal is confined in a fireclay vessel and subjected to strong heat. In the gas works, the place of the bowl of your pipe is taken by sets of tubes of fireclay filled with coal.

Now watch the end of the pipe stem. After a little while you will see what looks like smoke coming out of it. If you put a lighted taper to this smoke you may get a little flare at the end of the jet, but it will quickly go out. The smoke is chiefly steam and air that are being driven off from the coal and the inside of the pipe. There is, as yet, very little gas in it.

After a little while the jet of smoke will not be so visible and will show more willingness to burn, and then at last you will be getting nearly all gas and can light your jet, which will continue to give a good yellow flame until all the gas has been driven off from the coal.

Whilst the jet is burning you will probably see a little thick black substance oozing out of the small hole in the pipe stem. This is coal tar and is always produced in gas making. When your jet has burned out take the pipe from the fire, being careful not to burn your fingers, and, when it has cooled down enough, open it and shake the contents out into a tray or piece of paper. You will find a mass of coke and a good deal of tar. The tar will be all round the inside of the bowl of the pipe.

In a proper gas works the gas is led from the fire-clay retorts by a tube which dips down, on the top of the furnace, into a long gutter which is called the "hydraulic main." This main serves two purposes. It prevents the gas from blowing back into the retorts when the doors are opened to put in a fresh charge of coal and it catches the tar. The end of the pipe from the retort dips down under water which is always kept in the main.

The gas as it comes from the retort is, of course, very hot and it is also very impure. The impurities make it burn badly and they are also very valuable, for they contain many substances of use to man.

The first thing that is done is to cool the gas and take from it the ammonia with which it is strongly impregnated. This is done in a "condenser." This is usually a pipe with many bends in it. The gas passes slowly through the many bends and is cooled because the outside of the pipe is exposed to the air. The ammonia condenses and runs to the bottom, mixed with some tar that has not been caught by the hydraulic main.

On the side of the "condenser" away from the retorts is a kind of fan or pump which draws the gas from the retorts and forces it through the main to go through many other processes.

The gas is next "scrubbed" or washed. This is done either by letting the gas bubble through water or by passing thin streams of water through it. There are usually two scrubbers.

The gas is not even yet clean and pure. The gas still contains a very poisonous impurity that would be dangerous if it were allowed to remain. So it is passed through "purifiers." These are large, flattish boxes usually filled with trays containing slaked lime.

When the gas has passed through the purifiers it is ready for use and is stored so that it may be passed through pipes to the consumers in the proper quantities. It is first measured in a huge meter so that the gas works people may know exactly how much they are making.

A gas-holder, or "gasometer," as it is often wrongly called, is an ugly kind of structure, as every boy who reads this will know. It is a huge circular tank which rises and falls according to the amount of gas in it. In a pit beneath the gas-holder water is kept which prevents the gas from escaping as the holder moves. In the ordinary way this pit has to be just as deep as the holder is high. With very big holders this would mean a huge pit and a great amount of digging to make it. To get over this difficulty many big holders are made on the telescopic principle. Each piece is slightly smaller than the one in which it slides.

CHARCOAL MAKING AT HOME

YOU often want charcoal for one purpose or another. If you keep fowls you should feed it to them constantly, it should be put in the fibre in which you grow bulbs, and you cannot make fireworks without it. These are only a few of its uses.

Charcoal is not cheap to buy, but you can easily make it at home with very little trouble. It is an interesting thing to do, too, and you can get a lot of fun out of it.

You need a tin with a closely fitting lid. A golden-syrup tin with one of those flanged, press-down lids is just the thing. Bore a hole in the lid to take a small cork in which you have made a hole in which you can fit a short length of piping. Any kind of pipe will do, and if you can fix an old gas burner to the end so much the better.

Fill your tin quite full with short pieces of dry wood well packed down, jam your lid on tight, fit your pipe and set the tin on a fire. The fire mustn't be too fierce. Just a nice red glow is all that is required. If you can get the hot coals packed well round the sides of your tin you will make better charcoal.

After a while you will see steam coming out of the pipe. It will come faster and faster until there is a strong jet of it. Now apply a light to the jet. You will see a little flame flickering in the steam. Gas is coming off. After a while the steam will nearly disappear and you will find that you can light

the gas, whieh will give a strong flame. Keep the fire round the tin until there is no more gas eoming off and then take it from the fire and set it on one side to eool. When it is eold open the tin and you will find that all the wood has been turned into blaek chareoal. On the bottom and sides of the tin there will be a brownish blaek tar. This eontains Paraffine, Naphthaline and many other substances.

The gas whieh eame off and whieh you lit is ehiefly Marsh Gas and Wood Naphtha. Wood Naphtha is the stuff that is put in Methylated Spirits to make it taste nasty. Its scientifie name is Methylic Alcohol.

Section IV.—MISCELLANEOUS HOBBIES

CONJURING FOR BOYS

I THINK we may take it for granted that the great majority of boys are keenly interested in conjuring and find much pleasure in watching a magical entertainment. I will not waste words, therefore, in writing of the attractiveness of conjuring as a hobby. My aim shall be, in the limited space at my disposal, to show boys how they may derive the utmost possible amount of pleasure from the study and practice of magic.

After he has seen a conjuring performance for the first time the average boy is usually seized with a desire to become a conjurer. At the first opportunity he goes to a shop, buys a few pieces of conjuring apparatus, skims through the instructions, tries to follow them in practice, fails hopelessly, and becomes disgusted with the whole thing. The boy decides, for the time being, that conjuring is no hobby for him, but after he has seen another professional conjurer at work he is again overwhelmed by the fascination of magic, and he makes another attempt to become a conjurer. Maybe he fails again, and very possibly this procedure is repeated several times. If the young student is very enthusiastic he may eventually blunder on the right path to success, but he would have found it much more quickly and with much less trouble and expense to himself if he had asked someone to tell him the way.

That is what I propose to do—to show my readers the way to success in conjuring, and perhaps the best plan will be to ask each reader to imagine that he is sitting in this room with me and that I am addressing him personally. I say then to my pupil:

If you were going in for keeping rabbits, or some other animals, as a hobby, you would certainly take the trouble to learn something about those animals, how they should be kept, what they eat, and so on, before you acquired the first pet.

You should approach the study of conjuring in the same way. Learn something about it. Your simplest, best, and most economical plan is to get a copy of Professor Hoffmann's book, "Modern Magic," and study it carefully. It is one of the "classics" of conjuring, and there is no better book for a beginner. I advise you to read it all through, from the first word to the last. To do that will take a considerable amount of time, but it will be time well spent. When you have finished that book your eyes will have been opened, and you will have a good working knowledge of magic. You will have learned, for instance, that conjuring does not consist in a display of manual or digital dexterity, that some of the finest magical experiments are brought about by very simple means, and that the one thing which the conjurer has to trouble about when he is giving a performance is the effect which he produces on the minds of his audience. The methods by which he produces that effect are the conjurer's own affair; the audience are not concerned with them, and do not trouble about

them. If the conjurer can produce the right effect in a perfectly simple manner, by a method which is quite easy, so much the better for the conjurer. There are, of course, a great many magical experiments which demand a very high standard of skill on the part of the performer, but they are not necessarily the most effective to an audience.

You will have gained another great benefit from studying the book I have mentioned. It will have helped you to form your own taste in conjuring. You will know in what particular kind of magical effects you wish to specialize. Most beginners start off with the desire to do the most difficult things; they usually want to become sleight-of-hand performers in five minutes! They think that it must be a very fine thing to rely entirely on their hands for the production of their magical effects.

I will let you into a secret. Very, very few performers, even among those who apparently may be classed as sleight-of-hand men, rely entirely on their hands for the effects they produce. Many of them use little hidden pieces of apparatus, known technically as "fakes," to make their work easier for them, and when they do this they cease to be exponents of pure sleight-of-hand, but their audiences are none the wiser! You will soon find that if you are going to limit yourself to tricks of pure sleight of hand you will not go very far as a conjurer, and your programme will be very short, and it will need incessant rehearsals.

(I use the word "tricks" in this chapter in the popular sense; strictly speaking, a trick is an invention, by means of which a certain principle is

utilized for the production of a given result. In the same way, a magical effect is the final result due to the use of a certain trick, or tricks in combination. A magical experiment consists in the production of a magical effect, and a feat of magic consists in the successful performance of a magical experiment. But, as I have said, I will be popular for the moment, and we will talk about "tricks.")

I have not advised you to study Professor Hoffmann's book with the idea that you should try any of the tricks he explains—at least, not yet. You have not arrived at that stage in your magical education. Very possibly, long before you have come to the end of the book, you will be saying to yourself: "Oh, these things are out of date. This apparatus is too obviously a trick; no one would use this nowadays." Quite so. The book was written many years ago, and some of the methods which the author explains have been superseded by others. But I still affirm that the groundwork of magic is in that book, and that when you have got your foundation laid properly you can start to build on it yourself.

You can learn from that book how to palm a penny, how to palm a card, how to change one card for another, and so on. I advise you to learn none of these things at the outset of your magical career, because very possibly to do that may be a mere waste of time. The time to learn how to palm a card neatly is when you have decided to learn a trick in which a card must be palmed, and even then, if you can think of a way of doing the trick without palming the card, I should strongly advise you to

do so. Get out of your head the idea that conjuring consists in doing the most wonderful things with your hands. Nothing of the kind. Conjuring is a form of entertainment—nothing more, nothing less. Conjuring does not consist in setting the audience a puzzle and then asking them to solve it by discovering the secret. The secret you employ is a secondary matter. Your task as a conjurer is to entertain your audience, and as a means to that end you apparently achieve the impossible and that without an effort on your part.

Therefore be very careful to see, when you come to do your first trick, that the audience really understand what it is you are apparently doing. If you leave the audience in the dark your performance is a failure. For example, if you wrap a penny in one handkerchief and a florin in another handkerchief and then apparently make the coins change places the whole effect of the trick is lost unless you make the audience remember which handkerchief originally contained the penny and which the florin. You need not worry so much about the end of the trick; the audience can see that for themselves. Do not forget that while you are inducing your audience to understand clearly all you are apparently doing in a trick you must also entertain your audience by being as bright and amusing as possible. Some tricks and illusions require a certain solemnity of manner to make them thoroughly effective, but they are not likely to come your way just yet.

A conjurer's conversation (known technically as "patter") frequently serves a double purpose:

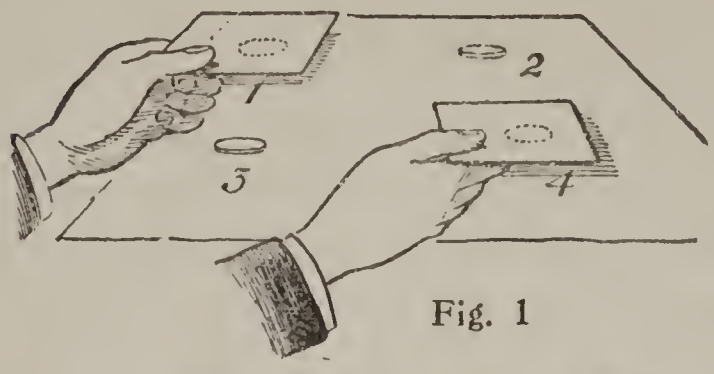


Fig. 1

"If I cover those you have just seen, you see the other two."

sometimes it amuses and instructs the audience at the same time—tells them what is going on—and sometimes it amuses and misdirects the attention of the audience at the same time. Hence there are tricks which cannot be done without "patter," because if they were performed in silence the audience would see through them. I am going to explain a trick of that kind, and I purposely begin with this trick because it is easy, effective, and requires no apparatus. You can do it anywhere with borrowed articles.

Take a large silk handkerchief or a dinner napkin and spread it out flat on a table with a thick cloth on it, or on the carpet. (You see, you do not even need a table for this trick.) Near the four corners of the handkerchief place four pennies. You will also need two stiff square envelopes. In order to make the working of this experiment quite clear I propose to call the four corners of the handkerchief by numbers, thus:

1 2

3 4

Hold an envelope in each hand, with the fingers underneath it and the thumb on the top. Tell your little audience that what you are about to do should produce an optical illusion, and then say something like this:

"If I cover the two pennies at the bottom of the square you see the top two." (Suit your actions to the words all through the experiment.) "If I cover the two on the left you see the two on the right; if I cover two diagonally opposite (2 and 3) you see the other two diagonally opposite, and if I cover those you have just seen (1 and 4) you see the other two. If I cover the top two you see the bottom two, and if I cover the two on the right you see the two on the left. (Leave the envelope at 2 and bring the other envelope, which has just covered 4, to 3, covering the penny there.)

Now for a word of explanation, because in this introduction to the experiment you have really done something which the audience do not know you have done. Go back to the previous paragraph, and you will see that you finish up by saying: "If I cover the top two you see the bottom two, and if I cover the two on the right you see the two on the left." When you covered the top two your right hand was naturally on Number 2, and when you covered 2 and 4 the hand which had covered 2 was brought down to 4 and the left hand was brought over to 2. In that last movement you have an important part of the trick. As the right-hand envelope comes away from 2 the left-

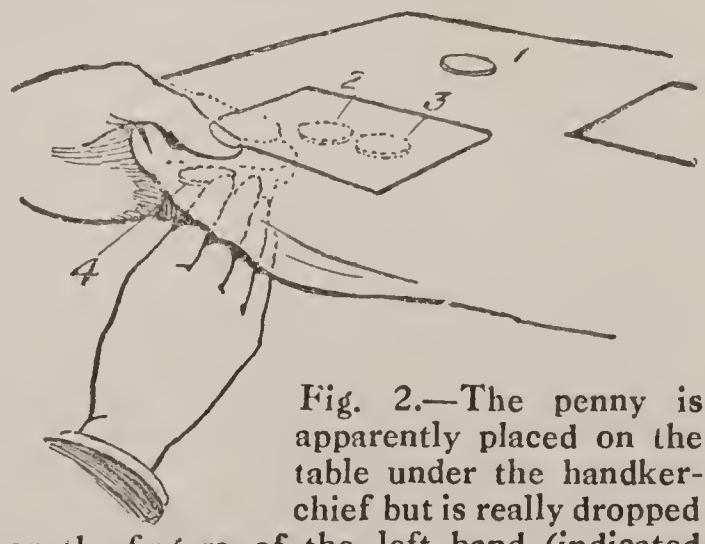


Fig. 2.—The penny is apparently placed on the table under the handkerchief but is really dropped on the fingers of the left hand (indicated by dotted lines) under the handkerchief.

hand envelope covers that spot so that the audience do not see that when you covered 2 with the right-hand envelope that hand secretly picked up the penny at that corner and held it under the envelope. The other envelope is left at 2, and the envelope which you hold over 4 for a second is then placed with the penny which you have held under it over 3. Thus, unknown to the audience, there are now two pennies under the envelope at 3 and none at 2.

How are you going to pick up the penny under the envelope so that the audience do not see any clumsy movements of the fingers ? Nothing simpler. Remember that your thumb is on the top of the envelope ; as you cover the penny merely press down on one side of it with your thumb and if the cloth on the table is fairly thick you will find that pressure on one side of the penny with the thumb raises the other side slightly ; the fingers are slipped under the penny and hold it flat against the envelope. You have no palming to learn ; the envelope covers the penny as it lies on the fingers of the right hand. You can learn that simple movement of picking up the penny under the envelope in five minutes, but what you cannot learn in five minutes is the way of saying your introduction and making the necessary movements with your hands in an easy, natural manner. Don't hurry about it. Directly you have secretly picked up the penny at 2 you will naturally feel inclined to get the other envelope quickly down on to the vacant corner 2, but do not appear to be in any hurry. Make all your movements slowly and deliberately. Now you have the penny under the envelope as you hold the envelope for a second

to cover 4, but you at once bring it over to 3 and leave the extra penny there, but so far as the audience are concerned you have merely been covering and uncovering the pennies, two at a time, with the envelopes. Now we advance quickly to the climax of our experiment.

Pick up the penny at 4 with your right hand. Lift the corner of the handkerchief at 3 with your left hand; the thumb should be on the top of the handkerchief and the fingers underneath. Openly place the penny under the corner of the handkerchief which is being held up a little way with your left hand and instantly take away the right hand; the audience will see that the hand is empty and will naturally think that you have merely slipped the penny under the handkerchief, but what you really did was to drop the penny on the fingers of the left hand which is raising the corner of the handkerchief. Tell the penny to pass through the handkerchief; pick up the envelope at 3 with the right hand, and as you draw the left hand away from the handkerchief take the envelope in that hand, thus covering the penny which you put there under the handkerchief. The audience see the two pennies already at 3 and think that the penny which you put under the handkerchief really passed through it in some mysterious way. Place the envelope in the left hand over the two pennies, taking care not to make any chink of the penny against the other two. Unknown to the audience there are now three pennies under the envelope at 3.

Pick up the penny at 1, and repeat all the last movements of pretending to slip the penny under

the corner at 3, finally leaving the four pennies under the envelope at 3. Now, the audience believe that there are only three pennies there, and that the envelope at 2 covers the fourth penny. Therefore, you can bring this little trick to a brilliant finish by saying:

"The last penny travels very quickly." Give the envelope at 2 a little click with your thumb and second finger and pick it up. The audience should be considerably surprised to see that the penny which they believed to be there has vanished, and before they have recovered from that surprise you raise the other envelope with your left hand and show the four pennies there.

Now you must practise that trick until you can do it perfectly, because it is within the reach of every boy; if you cannot do that trick well you are not likely to make a conjurer. Please note that it is a trick of pure sleight of hand, but sleight of hand of the simplest kind, and it is simple because you misdirect the attention of the audience in your opening introduction. You will also note that without that introduction you could not make the trick effective, because you would have no excuse for changing the positions of the envelopes several times before you started to carry out the rest of the experiment.

And now, since I am sure you are longing to do something which is much more difficult, I will show you the simplest way of doing a famous sleight-of-hand trick, but it is not pure sleight of hand, because you employ one secret piece of apparatus to help you. I have in mind the trick which is

known to conjurers as "The Billiard Balls," but since you will use balls which are much smaller than billiard balls, I suggest that you tell your audienee that the ball with which you are going to start the triek is a bagatelle ball.

The effeet of the trick is quite simple and straightforward. You hold one ball between the tips of the first finger and thumb of your right hand and produee a second ball between the first and second fingers; you subsequently produee another ball between your second and third fingers, and another between your third and little fingers. Then you drop all four balls on to a tray and give them out for examination; they are solid, and there is no seeret mechanism in them; anyone may examine them.

Unknown to the audience, you need a tiny piece of apparatus. This is half of a hollow ball which matches the other balls you are going to use; this thing is known teehnieally as a "shell," so we will call it by that name.

To prepare for the triek put two of the balls into the inside poeket of your coat, on the right-hand side. One ball is placed at the top of the left-hand pocket of the trousers, so that when you get your fingers into the top of the poeket you can easily hook the ball out into the hand. The shell is placed in the right-hand trousers poeket and you eome forward with the fourth ball in your hand; tap it on the table so that everyone may be eonvineed that it is a solid ball. Then hold it in the right hand, with the thumb on one side and all the fingers on the other (though you will not need all the fingers

to hold the ball) and the baek of the hand towards the audience. Say to your audienee:

"This little ball has a peeuliar knaek of passing through solid objeets; sometimes, for instanee, it will go right through my leg."

While you are saying this put the left thumb under the ball and your fingers over it, and apparently take it away from the right hand. What you really do is to let the ball slip down into the right hand, and you do this by merely taking the right thumb away from it. When you have done this you must turn your right hand round so that the fingers are downwards and the back of the hand is towards the audienee; the ball is coneealed by bending the fingers slightly. The audience believe that you have taken the ball away with your left hand, and you must hold the hand in the right way, with the fingers closed round, as they would be elosed if the ball was really there. (Put a ball into the left hand, close the fingers over it, and then note carefully the appearance of the hand. Then imitate that appearanee when the ball is not in the hand.)

The position of things at the moment is this: The audienee believe that the ball is in the left hand, but it is in the right. The right hand is brought down quiekly behind the right leg, and the left hand spanks the same leg. The right hand produces the ball from the baek of the leg.

All these movements are made very quiekly, while you are saying: "Sometimes, for instance, it passes right through my leg." Continue in this way:

"Sometimes it goes only half-way through."

Hold the ball in the same position as at first in the right hand. Bring the left hand towards the ball as though you were going to take it in that hand, and repeat the other movements, but instead of producing the ball from the back of your right leg slip your hand into your pocket and bring it out again with the shell over the ball. The appearance of the ball is not altered, and the audience should not suspect you of having added anything to it.

Openly take the ball in your left hand for a moment. Your secret object in doing this is to

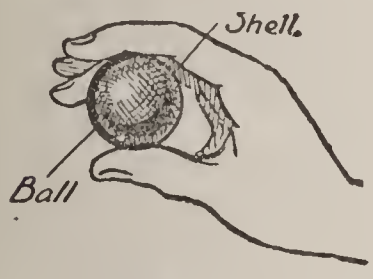


Fig. 3

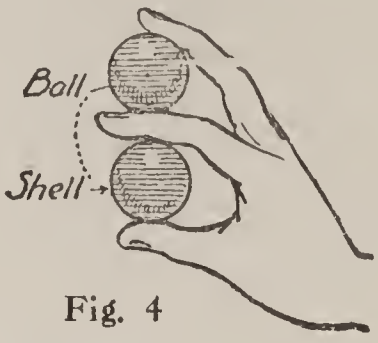


Fig. 4

The appearance of the second ball.

enable you to put it back in the right hand in the correct position for the trick. To ascertain the correct position stand for a moment near a wall. The shell on the ball should face the audience and the edge of the shell should be parallel to the wall. The shell should be held on the ball by having the thumb under it near the edge, and the first finger on the top, also near the edge.

Now turn the body slightly to the left and swing the arm right round to the left and back to its original position, while you say: "Just one small bagatelle ball." Your object in moving the hand in this way was apparently to show your audience that you had only one ball in your hand, but your real

reason for the movement of the body and arm was to enable you to hook out the ball from the top of the left-hand poeket of your trousers and conceal it for a moment in that hand. You need not palm it ; hold it against the inside of the hand by bending the third finger.

The other ball with the shell in front of it is held stationary for a second or two. Then say : " One and one make—two " ; at the same time raise the hand a few inehes and bring it down again. This movement prevents the audience from seeing another movement whieh you do not want them to see, because when you moved your hand you also brought your second finger close to the thumb, and therefore under the ball, and you lifted the ball out of the shell and held it between the first and second fingers. The audience are really looking at the shell between the thumb and first finger and the ball between the first and seeond fingers, but they think they are looking at two solid balls, and to assist in this deception you at onee bring the shell away with the left hand (in whieh, you will remember, you have a ball eoncealed). The shell goes over the ball in the left hand. The first ball is then allowed to drop into the right hand, and you knoek the two balls together to prove that they are solid.

Now return both balls to the right hand, the one with the shell over it to its original position between the first finger and thumb and the other between the second and third fingers, near the tips of the fingers. This position leaves a space between the first and seeond fingers.

Making the same movements as before, lift the

ball out of the shell again with the second finger, and you appear to the audience to have produced a third ball. Now, without moving the right hand, bring the left hand up to it and apparently take away the ball between the first and second fingers, but what you really do is to let it slip back into the shell.

Your left hand is apparently holding a ball. Extend your right hand upwards, bring the left hand towards the right wrist, and make a movement as though you were dropping the ball from your left hand down the sleeve. Say to your audience :

" This is really the easy part of the trick. I drop the ball in at one end of the sleeve, raise the arm, and it comes out of the other. Here it is. Of course you want a big sleeve."

You pretend to take a ball from the armhole of the coat sleeve, but what you really do is to slip the hand into the inside pocket of your coat (in which you placed two balls before you began the performance), hide one in the hand and produce the other. To hide the ball merely hold it against the palm by bending the third finger into the hand.

The right hand is holding a ball with the shell over it between the first finger and thumb and a ball between the second and third fingers. Place the ball which is in the left hand between the tips of the third and little fingers of the right hand. Remember that you have a ball concealed in your left hand, so that you must be careful not to show the palm of the hand to the audience while you are doing this.

Now, all you have to do in order to produce the fourth ball at the tips of the fingers of the right

hand is to lift the ball out of the shell, and you appear to have four balls there. Bring the shell away at once with the left hand, at the same time slipping the ball in that hand into the shell. Knock one of the balls in the right hand against the ball in the left and then put the ball in the left hand back into the right, between the first finger and thumb. The shell is concealed for a moment in the left hand. Say to your audience:

"I will show you an easy way of making all four balls disappear at once." This is apparently just a little joke of yours, because you merely put your left hand into one of your pockets, pull out a handkerchief, and throw it over the balls. In taking out the handkerchief from your pocket you took care to leave the shell behind in that pocket, and so at the conclusion of the trick you have nothing to hide. You can finish in this way:

"Of course there is not very much of a trick in making the balls disappear in that way, and as a matter of fact they cannot disappear in any way because they are quite solid." Then drop them on to a tray and let the audience examine them if they wish to do so.

I imagine that the billiard ball trick must have been performed at our entertainment some thousands of times by various performers; yet it is a trick which is always new and is always appreciated by an audience when it is done neatly and well. Naturally, I have had to simplify the trick a good deal in places, but I do not think that any ordinary audience will detect any difference in the experiment.

I put this trick in because I know from experience

that boys like to practise a trick in which they have to use their hands and fingers dexterously. You must not expect to learn the trick in five minutes or in five days; when you know it you know a very good trick. You can purchase the materials for the trick at any conjuring shop, and you will probably find that the usual set of apparatus consists of three balls and the shell, but a fourth ball should be bought. Take care not to choose balls which are too big for your hands; the larger the balls the more difficult the trick.

Here is a trick which requires very little skill, but you need to be fairly quick at simple addition and subtraction. This trick has also been performed on my stage, but I have simplified it, and at the same time, I think, improved it.

You show a clean slate to the audience; they see both sides of it. In order that the audience may be convinced that you do not change the slate you mark one side of it by writing in chalk any initials they choose. You wrap the slate in a sheet of newspaper and give it to a member of your audience to hold for a moment. Then you take a small blank card to a member of your audience and ask him to write any one figure he pleases on it. You hand the card round and have several figures written underneath each other in a single column. Someone adds up the column of figures and reads out the result. We will suppose the number is thirty-four. You quickly tear the card into the same number of pieces (the exact number is immaterial but you need an excuse for tearing up the card), and at the same time call upon your good fairy

Fig. 5.—The flap is dropped on the table and is afterwards hidden by a sheet of newspaper.

to write the answer to the sum on the blank side of the slate.

The person holding the slate uncovers it and finds the right answer to the sum there. Turning the slate over he sees the initials chosen for the marking of the slate; it is obvious, therefore, that the slate has not been changed; it is equally obvious, since a member of the audience is holding the slate, that it has not been prepared in any way.

I would also remind you that the card on which the audience set their sum is a blank card until they write on it, and the card is not changed.

This trick is performed with what is known as a "flap slate." The slate is usually made of painted millboard fitted into a wooden frame; a loose piece of painted millboard—the "flap"—fits into the frame but falls out directly you turn the slate over.

To present the trick place three or four sheets of newspaper on your table and the slate, with the flap side upwards, on the paper. Written on the slate itself but concealed by the "flap" is a number you have selected yourself for the trick; we will imagine it is 34.

Pick up the slate with the fingers on the top of the flap and the thumb below the slate. Turn the slate over two or three times, taking care not

to let the flap fall away, and write on the plain side of the slate (the side without the "flap") any initials chosen by the audience. Hold the slate with the right hand so that they can see the initials. Pick up all the sheets of newspaper with the left hand, so that everyone can see you have nothing concealed under the papers. Say to your audience :

"I think one piece of paper will be enough ; I am going to wrap the slate in this sheet of paper.'

While you are separating the top sheet from the others you are holding the slate in your right hand and the papers in your left. It is an easy matter to let the flap fall off the slate on to the table and to drop one of the sheets of paper over it. The slate is immediately wrapped up, and as the audience saw the initials chosen for the marking of the slate they are not likely to suspect that the other side of the slate is not what it was when they saw the slate in the first place.

Having wrapped up the slate, give it to someone to hold, and ask them to put it on their lap and place both hands on it. Then take your plain card and a pencil to someone and ask that a figure may be written on it. Other figures are added by other members of your audience.

Fig. 6.—Showing the flap (indicated by dotted lines) now hidden by a sheet of newspaper.

Now you know that the figure on the slate is 34,

therefore you have to watch over the figures which are being written on the card, and when they exceed 25 say: "That will do, thank you," and take the card away. (Do you see why you must mentally add the figures as they are written down and stop when they total 25? If you allowed the audience to go beyond that number and handed the card for the addition of one more number it is just possible that the last person might add a "nine," and then the total of the figures on the card would amount to more than thirty-four, which is the number on the slate, and therefore the trick would fail.)

It does not matter if the last number written on the card increases the total to 33, but what does matter is your accuracy in adding the figures "in your head" as they are written down. We will suppose that the last figure brings the total to 29. You take the pencil and your card in your hand, draw a little line under the column of figures, secretly add a "5" to the column, and ask someone to add up the sum. It does not matter what figures are written down; you secretly add a figure which brings the total to the figures on the slate, and you do this while you are apparently merely drawing a line at the bottom of the column of figures. Then you tear the card up into little pieces—in case any inquisitive person should want to examine the card afterwards and check off the figures with those who wrote them. When the card is in pieces the trick is practically over. The person holding the slate is asked to uncover it and hold it up so that everyone may see it, and while this is being done the conjurer

quietly removes the sheets of paper, and, of course, the flap under them.

I conclude with a simple but very effective card trick—one that appears to be difficult but is not. The conjurer takes a pack of cards to his audience and asks three persons to take a card apiece. He collects the cards, places them on the table for a moment, and holds the pack in his left hand with one side of the pack towards the audience. The conjurer says :

" I am going to place these cards in three different places in the pack," and he suits the action to the words, calling attention to the fact that the cards are well separated.

" As a matter of fact," he continues, " it does not matter where the cards go or how they go, because I am going to shuffle the pack." (This is done.) " I think you must be satisfied by now that the three cards which were selected are now well mixed up with the others. Now, this is a thought-reading trick. I am going to deal the cards slowly, one at a time, and so that I shall not get a glimpse of any one of them I will hold the pack behind my back and produce them one at a time. When you see the card which you chose will you please think of the word ' Stop,' and then transfer the thought to me, and I shall take the hint and stop dealing at your card."

The conjurer puts the pack behind his back, produces the cards one at a time, and stops at the three chosen cards ; the persons who chose them admit that the conjurer has done the trick correctly.

But the effect was not produced by thought-

reading. When the conjurer put the three cards back into the pack he dug his thumb nail into the right-hand corner of the back of each of them; this action produced a tiny bump on the other side of each of the cards. When the conjurer was dealing out the cards all he had to do was to feel with his first finger for the bump on the corner of each of the three cards. Quite simple and quite effective. This trick has been performed on our stage, but I have simplified the working of it; the trick could be done in a variety of ways.

In conclusion, a word or two of advice. Cultivate a pleasant manner. Learn your patter by heart, but do not repeat it in parrot-like fashion. Do not show a trick to anyone until you can do it properly. There is only one word on the signpost pointing to success in conjuring, and that word is —practice. Do not attempt to learn a lot of tricks. Be content with a few, but know them thoroughly; then you will be what you set out to be—a conjurer.

NEVILLE MASKELYNE.

VENTRILOQUISM

MOST boys have read Cockton's novel "Valentine Vox," and not a few have experienced a desire to emulate the hero of that entertaining story. A regard for the truth compels me to state that the majority of the feats attributed to Valentine are outside the range of possibility—quite beyond the power of the most expert ventriloquist who ever lived. Nevertheless, many of his "experiments" are possible of accomplishment—if you know how. And that is what I have to tell you.

"Is it a gift?" is the first and most natural question asked by persons on becoming interested in the subject of ventriloquism. No, it is not. Whilst it is perfectly true that some persons have a much greater natural aptitude for its acquisition than others, it is nevertheless a fact that ventriloquism is an acquired art; that is to say, one's ability to ventriloquize does not depend upon any peculiar or special formation of the vocal organs. Natural qualifications are necessary to attain proficiency in ventriloquism, as in anything else. The student must have sound lungs, a correct ear, strength and flexibility in the throat, and the skill to imitate. Further, he must have some competence as an actor, for the power to lead people's judgment astray without seeming to do so is one of the chief weapons in the ventriloquist's armoury, and a considerable factor in determining whether a person will be successful in the practice of the art.

"What is ventriloquism?" is the next question. It is correctly defined in Gregory's "Dictionary of Arts and Sciences" as "an art by which certain persons can so modify the voice as to make it appear to the audience to proceed from a distance. An exquisite delicacy of ear perceives every difference which change of place produces in the same sounds. Possessed of such an ear, and a sufficient command over the organs of speech to produce a sound in all respects similar to another proceeding from any distant spot, to the audience the sound which the ventriloquist utters must appear to proceed from that spot. By a peculiar modification of the organs of speech, a sound can be produced which in faintness, tone, body, and every other sensible quality, perfectly resembles a sound delivered, say, from the roof of a house opposite; the ear will naturally, without examination, refer it to that situation and distance, the sound which the person hears being only a sign which he has from infancy been accustomed by experience to associate with the idea of a person speaking from a housetop."

Contrary to popular belief, the ventriloquist cannot "throw" his voice; that is to say, he cannot make his voice explode at a distant spot without any sound being perceptible in the intervening space between the ventriloquist and the place where the sound appears. What the ventriloquist *can* do is to so modify his voice that it *appears* to proceed from a spot he has previously indicated by word or action.

Although the word "ventriloquism" as popularly understood covers the entire range of vocal

illusion, there are in fact three divisions, viz. ventriloquism proper, colloquialism and polyphonism.

Ventriloquism proper is the imitation of sounds as they appear when heard from a distance. The technical term is " distant voice," and it is brought into play by the performer when, for instance, he holds a conversation with an imaginary man on the roof, or in the cellar. It is also used when imitating the cry of a boy in a box with the lid shut, the muffled sound in this case being practically identical with the " distant " voice.

Colloquialism is the imitation of the human voice without any " distant " effect, when, for example, the entertainer apparently conducts a conversation with one or more mechanical dolls.

Polyphonism is really mimicry, the art of imitating sounds such as the cries of animals and birds, musical instruments, etc., without any attempt to deceive the listener as to the source of such sounds. The ventriloquist aims at deception, in that the sound he produces is not supposed to originate with him, but to come from some more or less distant spot. The polyphonist, on the contrary, simply imitates.

The foregoing is more or less by way of introduction and explanation, and we now come to the consideration of our subject from the practical side. It is not easy to explain in print everything connected with the art, but I will endeavour to convey my meaning in as few and as simple words as possible, so that the student may not be put to unnecessary trouble in picking out the essential points.

Before any attempt is made to experiment with the voice, you must be able to control the breath

so that you may hold it, without straining, for a considerable time. The correct way to breathe is through the nose, not through the mouth. Stand erect, take a deep breath through the nostrils, retain it in the lungs as long as possible, and then let it out gradually through the mouth. You will appreciate the value of this power to retain the breath later on when you have to give off a long sentence in a ventriloquial voice.

Next you must learn to control the facial muscles, so that you may be able to talk not only without movement of the lips, but also with absolute rigidity of countenance. Although it requires a considerable amount of practice to enable one to talk freely and naturally without moving the lips and nerves of the face, it is by no means difficult to accomplish. Practise before a looking-glass. Stand up, keep the mouth almost closed, so that the upper teeth just touch the lower lip, and watch that the expression of the face is a natural one.

The student may now commence to articulate. Standing in front of the looking-glass, and keeping the mouth in the position just indicated, go right through the alphabet without moving the lips. The vowels will present no difficulty, but B, P, M, and to a smaller extent F, and V, may cause trouble. Repeat the alphabet over and over again, for the object is twofold : first to acquire the habit of talking without facial movement, and secondly to articulate plainly with the lips still. Try it first by forcing the sound against the top teeth, keeping the tongue as low down in the mouth as possible. Then go through the exercise again, raising the tongue a little and

forcing the sound towards the back part of the roof of the mouth. You will find this enables you to repeat the alphabet in two quite distinct tones of voice. Next repeat sentences. A recitation, or any nonsense will do.

To become a successful ventriloquist one must be able to appreciate sound as it falls on the ear, so that the distant sound may be imitated. Nature is of great assistance to the ventriloquist in this respect, for it is very difficult to locate the exact direction and distance of a sound. If a person calls to you in the street, for example, and is not in sight at the moment, it is as likely as not you will turn in the wrong direction to ascertain whence the sound came. This uncertainty is very helpful to the ventriloquist, and it is the business of the ventriloquist to imitate sounds, not as they are heard at their source, but as they appear when they reach the ear.

But the ventriloquist must do something more than merely imitate sounds. He must "act" at all times. He must appear to be one of the audience himself, asking questions on their behalf, and apparently as anxious to hear the answer as anyone present. A good actor will make a much more successful ventriloquist than one who is an indifferent actor, because he is able by acting his part to govern the imagination of those who are looking on.

Now we come to the mastery of the three principal "voices" in ventriloquism—the "distant" voice, the "semi-distant" voice, and the "colloquial" voice. The "distant" voice, as has been said, and as its name implies, is the voice used when the performer desires to bring about the illusion of a person

calling from some distant spot. Although there are several modifications, all "distant" voices are practically the same. Call out "Hi!" in your natural voice, prolonging it a little, and opening the mouth well. Then close the mouth, letting the top teeth just touch the inside of the lower lip, and call out "Hi!" again, one octave above, but keeping the sound at the back of the throat, turning the tongue towards the roof of the mouth and slightly straining the stomach. You will find the sound is exactly the same as if a person had answered your call from a distance. If when making this second "Hi!" sound you keep your mouth still, and by word or action direct the attention of listeners to the spot from which you desire they should imagine the voice proceeds, the illusion will be complete. And there you have the secret of the "distant" voice in a nutshell. It can be made to approach or recede. To bring the voice nearer, the sound has to be released gradually from the back of the throat and brought forward in the mouth. If the voice has to die away in the distance, you just reverse the process.

The "semi-distant" voice is a modification of the "distant" voice, but sufficiently distinct to warrant being dealt with separately. It is the voice which is close by, outside the door or window at which you are standing. Before commencing the study of this voice you must get the sound as it falls on the ear well in your mind. If you propose to present the illusion of a man answering from the other side of a door, get a friend to stand outside the door and speak to you. Note the sound of his voice as it reaches you and endeavour to imitate it.

The faithfulness of the imitation will be the measure of your success. Having a clear and definite knowledge of the sound, try to reproduce it in the top part of the throat, keeping the breath well under control so that really you utter the sound without breathing. Keep to the same pitch and you will get a deadened muffled sound exactly resembling a person speaking in a passage with a closed door intervening. If the voice is to appear to come through a thicker substance, a brick wall, for instance, make the sound fainter, but a little higher.

Now we come to the colloquial voice—utilized when one wishes apparently to endow with speech one or more mechanical " figures," or for conversing with an imaginary person behind a screen. To produce these voices it is not necessary either to modulate or " throw " the voice. All colloquial voices, whatever the character, are based on two—the " old man " voice and the " old lady " voice. The " old man " voice—that is, the imitation of an old man speaking behind a screen, or through a " figure "—is produced by turning the tongue back so that the tip just touches the roof of the mouth, the ventriloquist speaking in as deep a tone as he can assume. Keep your lips still, the muscles of the face rigid but natural, and let out the sound from that side of the mouth nearest the figure supposed to be talking, or the screen behind which the man is supposed to be concealed. If you wish to imitate an Irishman or a Scotsman the voice is the same, except that the dialect is used. The " boy's " voice is produced in the same way as the " old man's," except that it is pitched higher and the sound sent more in the

direction of the nose. To get the "old lady" voice, speak in a high key through the nose, keeping before your mind the peculiar squeak used by the "Punch and Judy" man. This voice should have a kind of complaining wail in it. The "little girl" voice is similar to that of the "old lady," except that it is pitched in a higher key, is not so full, and is much brighter. Whilst the "old lady" voice is harsh, the "little girl" voice should be soft, sweet, and rather halting. The "baby" voice is very effective and easy to acquire. It is similar to the "little girl," but is pitched still higher, and is forced through the nose. If there is a baby in the house, study from Nature. These voices form the ventriloquist's stock-in-trade, and from them all others are evolved. Master these, and, by altering the pitch and tone slightly, you will be able to fit almost any character.

As I have already stated, it is in association with these colloquial voices that mechanical "figures," or dolls, are used, and it may be convenient at this stage to give some idea of the make, working, and cost of these aids to the ventriloquist, for as a matter of fact a ventriloquist entertainment in which a doll is used to join in a humorous conversation is generally more amusing and acceptable than "distant voice" effects, and is certainly much easier for the novice. The head of a ventriloquial figure is made of *papier mâchê.* The jaw moves on a long hinge working on a spring. The head is usually fixed to a shaft with a lever about half-way down to which is attached a wire or string running up to the mouth, so that the operator, with the shaft in his grasp, can, by touching

the lever with his thumb, open and close the mouth at will. The very small dolls have no shaft, but there is a hole in the back of the neck. The performer grasps the doll at the nape of the neck, puts his thumb through the hole, and moves the mouth by pressing the hinge. The more expressive heads have various additional movements, such as eyes to turn, wink, and roll, smile, look surprised, hair fly up, etc. These movements add to the fun, but are not really necessary. The bodies of ventriloquial figures in the smaller and cheaper class are also made of *papier mâché*, but in the case of large figures fitted with mechanical movements they are constructed mainly of wood. The back of the body is open, so that the performer can get hold of the shaft, which comes through the neck hole. The heads are not attached to the bodies as a rule, but can be taken out and placed inside the bodies for convenience in travelling. The cost of a good ventriloquial figure—and it is best to have a shapeable and reliable article rather than the mass of deformity, full of traps for the unwary, occasionally to be met with in toy shops—is anything between £3 and £10 or more, according to size and the number of movements with which it is fitted. The best and most perfect figures are made in Paris, but there are several English firms who manufacture for the professional entertainers. We cannot advertise them here, but if any reader who may be interested cares to communicate with me through the Editor of this book, I shall be pleased to put him on the right track of the real article. Incidentally I may mention that I shall be very happy to answer questions put

to me in the same manner in regard to any points in this article the student may not be clear about.

The third and last point we have to deal with is polyphonism: mimicry. If it is hard to convey in print one's actual meaning when dealing with ventriloquism, it is a great deal harder to make oneself understood when writing of mimicry, because of the impossibility of "spelling" some sounds. Let the ear guide you; read the following directions, which are as explanatory as words can make them; and study from Nature.

Dogs.—When a dog barks he does not say "Bow-wow"—his lips do not meet. Make the sound represented by the words "Ow! Ow! Ow!" as far down the throat as possible. For a terrier bring the tongue forward in the mouth, and for a very small dog direct the sound through the nose.

Cats.—Cats can be imitated by uttering a noise like "ngew-ng-ol-row," the sound being directed through the nose as high as possible.

Hens.—Press the lips together and utter a succession of "tucks," keeping the tongue well forward in the mouth and forcing the sound through the closed lips.

Cock-crowing.—Do not try to say "Cock-a-doodle-doo!" Roll the tongue back and make it "Ooo-o-oo-o-ooo," keeping the sound well down in the throat. For the bantam the sound goes through the nose.

Duck.—Roll the tongue back, say "Waack-waack"—not "Quack"—down in the throat, and send the sound through the nose.

Bluebottle Fly.—Press the lips tightly to-

gether except at one corner, where you leave just sufficient space for the wind to force its way out when you blow hard. This causes a vibration which resembles the buzzing of a bluebottle fly or wasp.

Sawing.—Rest the tongue against the bottom teeth, and make a sound as if trying to clear the roof of the mouth of phlegm, then draw in the breath through the clenched teeth, at the same time imitating the action of sawing.

Opening Bottle of Soda-water.—You are supposed to be holding in the left hand a bottle containing soda-water or lemonade, and the illusion is to force in the stopper, pour out the liquid, and drink it. To reproduce the sound of the forcing in of the stopper, draw the lower lip over the bottom teeth, and press the top teeth firmly down; force the bottom lip outward with an explosive "fizz"; keep up a hissing sound whilst going through the action of pouring the contents of the bottle into the glass, and then carry the glass to the lips. The pressure of the edge of the glass against your lip will alter the sound, which is gradually reduced in volume as the liquid is supposed to disappear.

We will now assume you have studied the art of ventriloquism in its entirety—that is to say, you are capable of producing the "distant voice" effect, can speak through "figures," and can imitate sounds—and wish to test yourself before your friends in the "Theatre Royal Back Drawing-room." Let us get the "lay-out" for a test of this character. You have provided yourself with a "figure"—say, a boy—and you have arranged a dialogue. Take the bay-window end of the room for your stage, and

seat the audience in rows at a respectable distance. Keep people in front of you; do not let them stand at the sides.

Get as far away from the audience as you conveniently can, for in ventriloquism distance certainly lends enchantment. The effect is better and infinitely easier to attain than when people are crowding around. You have a folding screen, placed well back, with your "figure" behind it. Step forward and explain in a few words what are your intentions. A conjurer should never explain beforehand what he is going to do, but a ventriloquist should, because, as I have said elsewhere, when people expect to be deceived in a ventriloquial sense, they assist by their imagination to deceive themselves. Then commence with the "distant voice," calling to Bill on the roof, gradually getting the voice nearer until it is behind the screen. Bill finds his wife, boy, and little girl there. You now get on to the colloquial voices, holding a conversation, as humorous as you can make it, with the man, woman, girl, and boy behind the screen. Send the man off, making his voice fainter and fainter as he disappears in the distance, raising the pitch and reducing the sound the farther he gets away. Now bring the figure of the boy out from behind the screen, place him on your knee and carry on a previously concocted dialogue. A "cheeky" boy who asks impertinent questions or returns saucy answers will always make a "hit." Let him finish by singing one verse of a song. Replace the boy behind the screen, and then introduce as many of the polyphonic imitations as you are capable of.

FRED RUSSELL.

THE MICROSCOPE AS A HOBBY

THE microscope has revolutionized man's outlook on life, and, although Nature has not yet given up her greatest secrets, step by step we advance along the path of progress. One cannot do better than make a hobby of the microscope; in fact by doing so we open up a new world, and, like the pioneers of old, plunge into the unknown.

Whether you buy a microscope or try, in the first instance, to construct one for yourself, does not matter very much; even if you make up your mind to study nature with the aid of a single lens, you will find the microscope hobby a fascinating one. If you intend to buy a microscope it is as well, first of all, to consider the all-important question of funds. Microscopes can be bought new for any sum from a shilling or two, up to, well, many pounds; Messrs. Gamage, of Holborn, have a good selection. The smaller ones are, of course, in some instances, mere toys; a student's microscope would probably cost anything from 30s. to £3 3s. A good instrument of lower power might be had for 15s. to 20s., but the price you give must depend upon whether your ambition induces you to seek for high power, or whether you are willing to walk before you run.

Microscopes can also be bought cheaply, if you are content with a second-hand instrument. Telescopes, microscopes, and cameras are frequently advertised in the *Exchange and Mart*, but I need hardly remind you that care must be taken

when answering an advertisement; second-hand articles are not always in good condition.

Sketch 5 on the accompanying diagram will give you an idea of what a fairly high-powered student's microscope is like. Such an instrument would probably cost £3 new. I do not suggest that you shall buy one of this kind; as I said just now, that is a question which will probably be settled by the state of "the funds." *

As you may decide to buy an instrument, I should explain that there are two distinct kinds of microscopes—that is to say, all of them are either simple or compound. In a sense a single convex lens (as shown on Sketch 1) is a simple microscope, for O, the lens, will magnify A, the object to be viewed. Sketch 2, however, shows a simple form of compound microscope, the object viewed is enlarged by O (the object-glass), and the eye piece (E) presents the image to the eye. Of course few compound microscopes are as simple as this one, and on Sketch 4 you will see a combination of three lenses—the main principle is the same, however.

Simple microscopes were undoubtedly the first instruments invented, but just when they came into use or who invented them is unknown. It is believed that the Chinese had magnifying glasses long ago, but simple microscopes seem to have been in use in Europe before 1600. One Lieberkuhn brought out high-powered instruments of this kind, and glass globules, which gave great magnifying power over

* "How to Make a Microscope" (*see* "Something to Make" in Modern Boy's Library).

a very limited space, were mueh sought after about the time that our old friend Samuel Pepys lived.

Compound microseopes are made in so many different styles, and vary so mueh in power and the manner in which the lenses are arranged, that it would be impossible to describe even a few of them in this article. The point which is of interest to anyone about to make a hobby of the microscope is that it is possible to get a great deal of pleasure

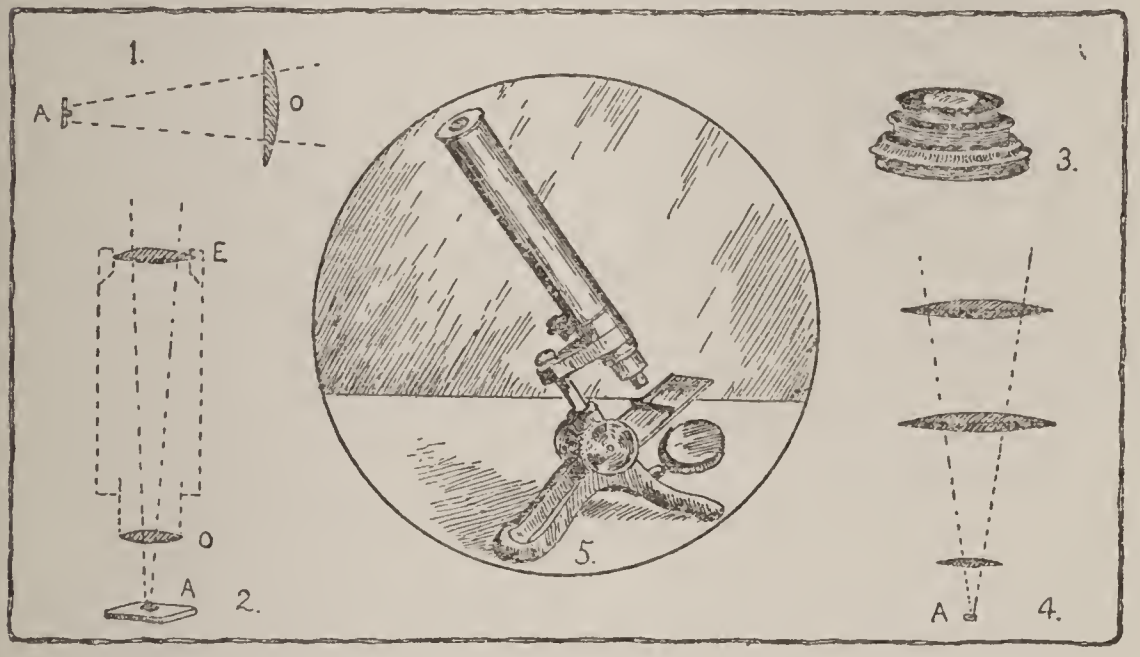


Diagram 1

and instruetion out of a simple instrument, but for anything like general researeh work, even if condueted for amusement, it is desirable to get a compound mieroseope of fair power.

I have about a dozen lenses of various kinds, and, just before I eommenced this article, I made a few experiments with some of them. Probably many of you own teleseopes, and you may like to know how I got a eombination which made a pieee of cotton look like, well, rope, and "drew up"

a serap of newspaper until it looked as rough as a blanket. I took two of the lenses from the eye-pieee section of a Dollond teleseope, and placed them upon the objeet-glass taken from a small opera-glass—the whole arrangement is shown on Sketeh 3. Many of my readers may like to test some of their teleseope lenses in this way.

I have now dealt with the instrument itself, and, after some eonsideration of the "ways and means," no doubt you have deeided what you ean afford to buy—perehanee you have already made the purchase. Now what are we to do with our mieroseope?

If you have a cheap instrument it is possible to find hundreds of things that are most astonishing, even when viewed through a microscope of no more power than that possessed by my three lenses (shown on Sketeh 3). Try a piece of glass-paper, and you will see something like the inside of a eave of crystal.

As it is probable that most of my readers will, at any rate, commenee with a mieroscope of eom-paratively low power, they may wish to begin work by studying eommon everyday objects. A great deal of pleasure can be obtained by placing ordinary flowers under even a simple mieroscope. Salt grains, if looked at in a strong light, are very beautiful. If you have a mieroseope properly fitted with a mirror, ete., examine these common objects by reflected and also by transmitted light.

A trip into the eountry will be an outing indeed if you go with the intention of bringing home items for the mieroscope. The sea shore, too, should be your "happy hunting ground"; for example, Alum Bay sand should be worth examining. Certain

seaweeds give good results, in fact, old ocean is a perfect store-house of treasures.

I should, perhaps, add a few words on mounting and selecting objects for the microscope. For this you will need slides, cover glasses, a section cutting knife, dissecting needles, a small pair of scissors, etc.; I have already mentioned some of the mounting media, and, particularly for botanical specimens, methylated spirit, glycerine, and a paint brush are needed.

Let us deal with botany first. My sister, who is devoted to this subject, suggests that you proceed in the following manner: Study first ordinary flowering plants, because they are simplest, then proceed to pines, ferns, mosses, seaweed, algæ, etc. In ordinary plants sections should be cut of stems, roots, leaves, etc., flowers should be dissected and each small part examined. To cut sections hold the specimen between the thumb and fingers of the left hand, then slice *very* thinly, taking care to keep the knife always wet with methylated spirit. Remove the section from the knife with a small brush, drop glycerine upon it, and cover it with a glass slip. (I think Messrs. Gamage, Limited, of Holborn, will be able to supply all the materials, etc., mentioned here.)

In sections of leaves (which should be rolled to cut) study veins, shapes of different cells, and look for pores in under surface. Cut through buds and notice the arrangement of young leaves. Young marrow or sunflower stems are good specimens.

In spring the catkins of trees, such as the willow, the poplar, and the hazel, might be studied. With the needle dissect the catkin, and put each floret

on the slide. With small plants study all parts as far as possible—roots, stems, leaves, flowers, and fruits. Some small fresh-water algæ are very suitable for beginners, these may be placed on the slide whole, and, being fairly transparent, the cell formation can be seen. Those specimens which are best mounted dry should be treated in the manner given below.

Ebonite cells should be obtained for mounting dry objects, and these cells should be fastened upon glass strips with some of the special cements sold for this purpose. For very minute entomological specimens use mounting needles (for lifting) and gum. In mounting dry objects take care that there is no damp in the cell before cementing the thin cover glass over it. Some specimens are mounted in Canada balsam.

The scales of insects are interesting things to study and so are the various minute parts of tiny insects. Of course, I do not know what kind of instrument you have obtained, therefore I must speak somewhat generally, but with a microscope of high or fairly high power the foot of a fly is an astonishing object. Microscopes of high power will show *insects upon insects*—parasites upon big beetles, for example.

If you have gone in only for, say, a combination of three lenses (as shown on the diagram), or are even reduced to a single lens of no great power, do not despair. Plants can still be studied, although not, of course, to the extent mentioned above, and a fly as it walks along a table is worth examining with a large lens.

The eggs of insects are well worth studying, and there is much to interest you when the insect has reached the grub stage. The scales from the wings of moths and butterflies make good specimens. Need I mention the ant, the bee, and last but not least, the spider.

I trust this brief outline will lead you to definite study of the mounting (which has many branches) and selecting of specimens.

With microscopes of high or moderately high power, I strongly advise you to purchase some of those properly prepared microscopic slides which are sold by reputable firms, which, used to this work, can turn our better slides and give you a more interesting range of subjects than you could obtain in any way by yourself. Of course, if you have been able to purchase a student's microscope, quite a new world lies ready for you to examine. But I must act on the assumption that possibly two-thirds of my readers will not be able to expend any great sum on a hobby of this sort, and I must write my article accordingly.

With a high-powered microscope the hydræ to be found in ponds or streams, clinging to water plants, can be studied. It is interesting to note that, as long ago as 1739, one Trembley, of Geneva, was able to study these little creatures, which proves that there were instruments of some power even in the days of Dick Turpin, of happy, or shall we say unhappy, memory.

Even with a good, strong, magnifying glass there is a great charm in examining minute photographs if they are quite sharp. I mention this

beeause I am very fond of examining them myself, using four lenses taken from the eyepiece seetion of a teleseope, which makes a mieroscope just suited in power to this work. The photograph must be plaeed so that a very strong beam of light shines upon it, then the lenses must be brought quite close to it. I should add that the photograph should be placed upside down, or the picture seen will be inverted. I have some very tiny photographs of towns, taken perhaps fifty or more years ago, and it is eurious to see the people—and particularly the children—in their old-fashioned dress.

Speaking of minute photographs and microscopes, whole pages of newspapers were reduced by photography during the siege of Paris in 1870. To the naked eye these photographs looked like little squares of paper, grey with tiny dots. The serolls were placed in the quill of one of a earrier pigeon's feathers, and, when the bird arrived in the besieged city, the seroll was extracted and the printing (much enlarged) was thrown upon a sereen by means of a microscope and the electric light.

Hobbies should be colleetive as well as individual, if I may put it thus, and, as in the case of the teleseope hobby, I suggest that you should try to form a little "syndicate." In Ameriea they form syndicates for every coneeivable purpose, and, even if the funds at the disposal of your tiny "corporation" consist merely of the clubbed poeket money of, say, half a dozen boys, they will go farther than the amount that can be saved by one lad. It might be worth while to have a sixth share in the ownership of a good student's microscope, and after the first

outlay, the efforts of the "syndicate" could be devoted to buying slides, etc., for the instrument. Yes, the club idea is well worth considering.

There are many good books and handbooks upon microscopic work which are suitable for the amateur. "Half-hours with the Microscope," by Dr. Ray Lankester, and "Common Objects of the Microscope," by the Rev. J. G. Wood, were both published at 1s. before the war, but probably they cost a little more now. In taking up this, or for that matter any other hobby, you must be systematic; it is of little use to buy, or even to make, a microscope, use it for, say, a week, and then throw it aside. And it is not always the boy who spends most money on his instrument who does best in the end. If you have, first of all, just to fit up a makeshift, possibly you will get as much pleasure and instruction out of it as your chum does from his much more expensive outfit. If you have taken up the subject *in earnest*, it is pretty certain that you will not long be contented with your makeshift, and will contrive to get a better instrument, for "where there's a will there's a way."

Diagram 2

As it is advisable that you should have some knowledge of the various lenses, I give a small diagram which will be of interest if you possess any kind of microscope.

Everyone knows what a common magnifying glass is like, but there are many other forms of lenses. The plano-convex lens, shown on the smaller diagram (A), is a very simple one, and B, a double convex lens, is, you will say, the common or garden order of magnifying glass. Speaking of this kind, I made a rather curious experiment some years ago. I obtained two thin watch glasses and cemented them together, leaving two small openings on the edges exactly opposite each other. I then filled the space between the glasses with water, as well as I could, afterwards sealing the openings. This made a rather powerful glass, but partly because I made and filled the lens very badly, and partly because the glass was poor stuff, I could do very little with it.

It is not my intention to describe combinations of lenses, but, in order that you may form some idea of the startling difference in the apparent size of any object when viewed through a lens of very moderate power, I give two pictures (in circles) showing a tiny sprig of a minute weed. The sprig in the large circle is magnified not more than three times. Imagine the effect produced by a telescope —that made by Ramage, for example—which magnified 6,500 times.

Reverting to the lenses A B C and D, shown on the small diagram, I should mention that C is a double *concave* and D a plano-convex lens, consisting of two sections of different kinds of glass cemented together.

THE TELESCOPE AS A HOBBY

POSSIBLY some of my readers will be surprised at the title of this article, for few lads make a hobby of the telescope. Yet a great deal of pleasure can be obtained with a good instrument, and if we take up stamp collecting until we go "stamp mad" and are ready to study anything connected with that hobby, why should we not take the telescope seriously? At a very early period of my life I became the proud possessor of a "spy-glass," but I think it was broken up in a wild attempt to make a camera. As a big lad I managed to buy a "Dollond Night or Day," and this excellent instrument I still possess. It is a rather powerful telescope, and, although somewhat heavy for carrying about, it has crossed the Channel with me more than once, and I should not like to say how many times it has "knocked about" at yacht races and up and down the Solent.

Of course, the first thing to do is to obtain your telescope. You can buy one or make one.* I "picked up" my "Dollond" at a sale, quite cheaply, and it was in very fair condition—a dent here and there, nothing more. There is, as of course you know, a difference between a pair of binoculars and a telescope; then we have refracting and reflecting telescopes. Briefly a refracting telescope consists

* "How to Make a Telescope," in "Something to Make," in Modern Boy's Library.

of an object-glass (which is the lens nearest to the object viewed) an eyepiece, a tube to shut out all light except that which comes into the instrument through the object-glass, and a sliding arrangement by which the lenses may be adjusted. These are the essential parts. In reflecting telescopes the image is formed by a concave reflector, from which it is transmitted to a plane mirror and viewed through an eye-piece (*see* sketch).

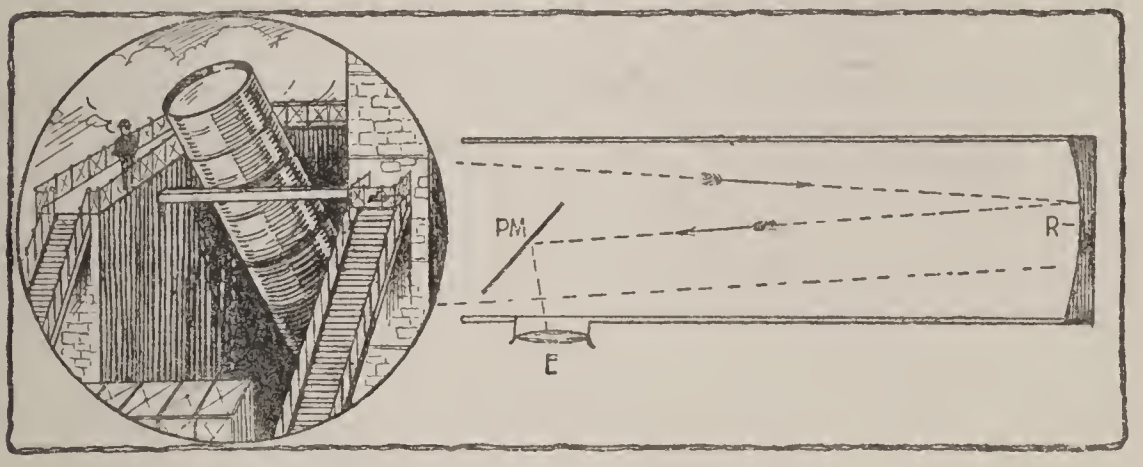
If you are buying a telescope, do not go in for one of those wonderful instruments sometimes advertised for, say, 3s. 6d. or 5s., and " warranted " to show a church clock at seven miles, flags at ten, and hills at, well, almost any distance. When writing to the makers, if you say exactly what you want, and the price you are prepared to pay, the firms will advise you. A great deal of enjoyment may be got out of a 3-draw tourist telescope—such instruments are obtainable for a moderate sum.

A good second-hand telescope is not to be despised, if in good condition, but, if you know little or nothing about telescopes, get a friend who does to examine any instrument you think of buying.

If you wish to study the heavens, you can do so—to a limited extent, of course—with any good telescope, fitted with a suitable eyepiece.

Having selected your instrument you are free to pursue your hobby, and a very fascinating one you will find it. For example, it is astonishing to note what a number of things you discover with a telescope, things which in the ordinary way pass unnoticed. Take your telescope to the top of a high hill near your home, some clear evening, and

spend an hour or so turning it in every direction. You will find things of the very existence of which you were unaware previously. I remember, some years ago, looking out over Southampton and its docks from the top of a house perched high up on the Woolston side of the Itchen. Miles beyond Southampton there was a big white house, which I could see quite distinctly, but, although I have since tried again and again to locate that house, I have never been able to do so.



The Great Rosse Telescope

If you have a taste for ships and the sea, you will find a telescope a very valuable instrument. It is pleasant, for example, to sit down under a shady tree on the banks of the Solent, during the height of the yachting season, and watch the racing yachts. In such a place there is always something to interest a lad, and the extended range of vision given by a telescope adds very much to one's enjoyment. One sees the smoke of a big steamer out towards the entrance of Southampton Water, and instantly the faithful telescope is adjusted and pointed in that direction. Yes, it is the huge three-

funnelled *Majestic*, the biggest ship in the world, bound for New York. On she comes, and, presently, with the aid of your glass, you see the passengers on her decks, and the officers on the bridge.

Or, if you cross the Channel, think of the joy of turning your telescope upon the misty coastline which looms up ahead, after you have been perhaps two hours out of sight of land. Possibly this is your first glimpse of a foreign country, and as the details gradually "come up," just as they do when a photographic plate is being developed, you almost fancy you are Columbus on the threshold of a new world.

If you have made a hobby of the telescope, you will long to know all about the best instruments and the discoveries that have been made with them. I believe our old friend Robinson Crusoe called his telescope a "prospective" glass, and his was probably not a much improved instrument to that used by Galileo—which magnified, I believe, only three times. Yet with his poor little telescope Galileo was able to prove what had previously been doubted, namely that the moon was not a self-luminous orb, but a solid, earthy globe, more or less like our earth.

To test the crude principle of the telescope take one of the eyepieces from any good opera-glass, and try it upon, say, a reading-glass. Hold the reading-glass in your left hand and the eyepiece in your right, then move the latter to and fro until the image formed by the reading-glass is brought up sharp and clear by the eyepiece. In the telescope, this is done by adjusting the tube containing the eyepiece. Even this crude arrangement will bring objects in front of the big magnifying glass

quite near to you, but obviously tubes are needed to exclude any light which does not come through the object-glass. Nevertheless you have the rough idea of the telescope. Of the refinements and improvements which have been made since men first fitted crude lenses to leaden tubes, one can say but little in a short article, but, if you are really " bitten " with the telescope hobby, you will want to look up such matters, just as the stamp collector gathers information concerning watermarks and errors.

It will add to your enjoyment if you can persuade some of your chums to take up the telescope hobby. Between you you might buy several telescopes of various makes, or you might club together and buy a fairly large astronomical telescope. You could get a good telescope of this kind second hand, for a very reasonable sum. At any rate, if several friends form themselves into a little " telescope club," shall we say, better instruments can be bought than would otherwise be possible.

The mystery of Mars deepens as time goes on, and always we are hearing a great deal about the red planet. Even if you form a " syndicate," and buy a fairly powerful telescope, do not expect that you will be able to see the famous " canals " on Mars, or that you will be able to settle the much-debated question as to whether there is life on that far-off world. The moon is your " happy hunting ground," for even with my Dollond telescope the outstanding features on the moon's surface can be seen with great clearness. Before the moon is quite full, turn your telescope upon the illuminated portion of its surface just where it merges into the

dark part. Even with a telescope of very moderate power the jagged roughness of what are, undoubtedly, lunar peaks and mountain ranges can be plainly seen. Probably you will not be able to do much in the way of studying the planets, for even the nearest of them revolves round the sun at such an immense distance from the earth that—as in the case of Mars—even the biggest telescopes give us but a poor idea of these worlds which are so mysterious. Yet in spite of the limitations which beset the amateur, I am sure you will turn your telescope towards the heavens, for the mystery of other worlds attracts one even during the "shilling spy-glass" period of one's life.

Many great men have made the telescope their hobby. As early as 1806, John Ramage, an Aberdeen merchant, began to construct reflectors, and at last built a fifty-four-foot telescope, which magnified 6,500 times. Lord Rosse, too, made the telescope his hobby (probably you have heard of the huge reflector, of fifty feet focus, which he built at his seat, Birr Castle, Parsonstown). This great instrument weighed four tons, and when turned upon the moon it disclosed its mountains and valleys almost as clearly as they would appear to an airman flying very high above our satellite. It was said that had there been a building the size of one of our big London railway station, sit could have been seen with this instrument.

You cannot ride your hobby so far as this, but, if you develop an interest in telescopes, you may go far. You will, of course, take your instrument to pieces frequently in order to clean it; all the

Fig. 1.—The Figure

Fig. 2.—The Landscape

Fig. 3.—The Finished Picture

PUTTING A FIGURE INTO A LANDSCAPE NEGATIVE

See page 231.

Fig. 1.—Print from Original Negative

Fig. 2.—Print from Blocked-out Negative

Fig. 3.—Showing Print with the New Background

"DOCTORING" A DAMAGED NEGATIVE

See page 231.

lenses should be very carefully cleaned and polished. You will then note how the stopping down reduces the amount of available light. Those of you who go in for photography know that one of the drawbacks—in some respects it is a drawback—is that a lens must be stopped down to get a sharp image. You will be able to form a good idea of this by studying your telescope when you take it to pieces.

Unless you manage to pick up a rather big telescope as a bargain, the question of a stand for your instrument will not arise. And if you do "strike a bargain" and become the proud possessor of a really fine telescope, probably the stand will be included for the price asked. It is possible to get sound and powerful instruments second hand, although, of course, the opinion of an expert should be taken before a lot of money is paid away.

Possibly you will be interested to know the difference between an achromatic and a non-achromatic lens. The first-mentioned type is just a disc of glass, thick in the centre and thin at the edges (if convex), or thin in the centre and thick at the edges (if concave). You have noted, of course, how, when looking through some thick magnifying glass, one is apt to see "all the colours of the rainbow," but this is a fault which can be cured. It was Dollond who, about the year 1760, invented a lens which consisted of a combination of crown and flint glass sections, arranged so that the colour tints produced by one section were "killed" by the other; in this way the image shown was produced in its natural colours. Thus he introduced the non-achromatic lens, but, of course, his first crude attempt has been

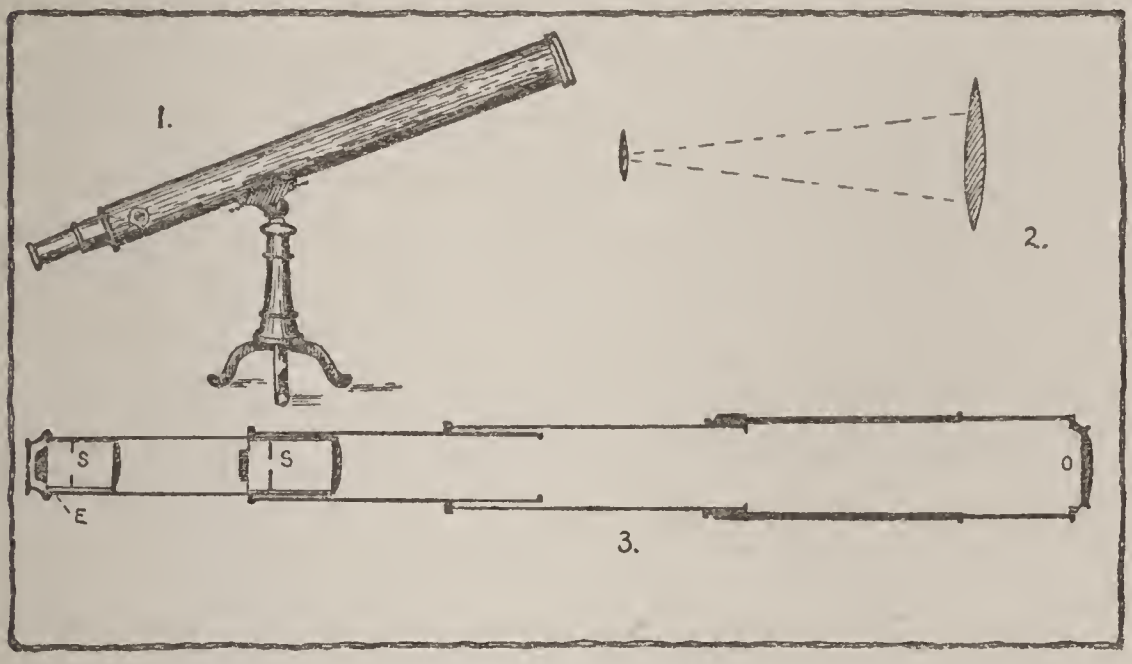
improved upon in these days. We have now upon the market lenses as perfect as it is possible to make them, combinations suitable for every purpose to which a lens can be put. In the advertisements we read that such and such a lens has been corrected for "chromatic and spherical aberration and for astigmatism." A good lens for a camera may cost ten guineas, and a great deal more in special cases. What the object-glass of a big astronomical telescope may cost, I leave you to guess.

In a short article it is neither possible nor desirable to introduce highly technical points. If I have started you upon a new hobby, probably you will wish to read up anything and everything connected with telescopes and telescope construction. Most free libraries contain many excellent books upon this subject, and upon astronomy. Dive into these as deeply or as lightly as you please, but before I close I must describe the diagrams.

Sketch 1 shows a small astronomical telescope —small, of course, only when compared with the huge instruments used at observatories.

Sketch 2 shows the simplest form of telescope; the large lens is the object-glass and the small one the eyepiece. This is, of course, the very simplest form of telescope, and a glance at sketch 3 will show you the construction of my Dollond to which I have referred in this article. o is the object-glass, and you will note the four lenses in the eyepiece section. What I particularly wish to point out to you is the stopping down of the lenses at s s.

The smaller sketch shows a reflecting telescope. R is the concave reflector, and the dotted lines and



Sketches 1, 2 and 3

the arrows show how the image is formed on this reflector as the light enters the tube. A plane mirror (P M) is placed as shown, and the reflection in this mirror is viewed through the eyepiece (E). This is a simple type of reflecting telescope; but glance at the little sketch in the circle. There you have the upper part of the great Rosse reflector; note the size of the man as compared with this huge instrument.

As I strongly advised you to club together and buy a telescope of some power, it may be that you have obtained a second-hand astronomical instrument. With this the study of the moon will be interesting indeed. Galileo discovered the mountains and valleys on the moon's surface, and, if you have a telescope of fairly high power, turn it upon our satellite after the new moon, when the shadows cast by the lunar mountains can be plainly seen. The "crater mountains" are like—well, those "forts" which children

make on the sand, or perhaps a gigantic sand-hill with the middle scooped out would give a better idea of their formation. The dark patches on the moon's surface can be seen with the naked eye, but with a telescope—even of moderate power—what were once called "seas" are objects of great interest, even to a casual observer. These dark patches are, of course, not seas but plains, and the enclosed or "walled" plains may possibly have been huge craters at some remote period.

You should not miss an eclipse of the moon, which is a very interesting phenomenon. With regard to the study of the sun, however, it is as well to warn you that unless very special precautions are taken you may damage or even ruin your eyesight. Smoked glass, of course, dulls the sun's glare, but I am rather inclined to leave Old Sol alone, although the sun-spots are interesting.

I have already mentioned that you must not expect to see details on the surface of the smaller planets. Jupiter, however, might be worth studying if your instrument is of good power.

Comets are, naturally, objects of interest, when they appear, and at such times the members of your "telescope syndicate" will be much sought after. You should study these "wanderers" very closely.

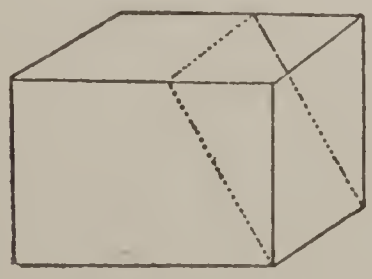
If you take up the telescope as a hobby, examine as many instruments as possible and note the principle upon which each is constructed. Probably some of your friends may have expensive telescopes, and they would, I am sure, allow you to test them thoroughly. If you can make friends with an expert who deals

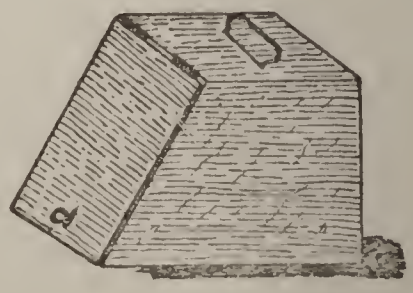
with every kind of glass so much the better. I once made friends with an expert on typewriters, and I learnt more from him in an hour than I had previously learnt in six or seven years. Five minutes *conversation* with an expert is worth pages of written instruction. I should particularly call your attention to that beautiful and expensive instrument the stereoscopic binocular. You will hardly be able to purchase one of these, but if you have taken up this hobby you will naturally be interested in them.

The use of "night" glasses at sea is also an interesting study. I remember being on board a fast steamer on Southampton Water, one very dark night, some years ago, just after several small boats had been sunk. The look-out man was worried, for the river was crowded and the skipper kept up full speed. I know these waters well, and tried the man's glass to make out what was ahead. This glass was a good one, but, with the glare of the dock lights ahead, it was almost impossible to see what was right under our bow.

MAKING A COAL-SCUTTLE

YOU can make a useful coal-scuttle from a box. A good size for the box will be 18 in. deep, 14 in. wide, and about a foot long. Take away the lid of the box and saw from a point 7 in. from the end to the corners on the corresponding sides of the box. The dotted lines shown in the sketch indicate about where the saw-cuts should come. In this way a slope of about sixty-nine degrees will be secured. Cut a lid for the box and affix this with two hinges. Rub all the wood down well with glass-paper so that it is thoroughly smooth. Attach a handle of bent wire to the top of the scuttle. For strength the ends of the wire might be carried right through the top of the scuttle, holes having been previously bored. A nob such as a small drawer-handle would do to lift up the lid. Paint the whole of the scuttle black, giving three coats. Rub down between two of the coats after the paint is dry. Then apply the final coat, finishing off with varnish.





ABOUT SOME OF THE FISH—AND AN AQUARIUM

SOME may say there is not much interest in an aquarium, and think that all one has to do is to buy one or two goldfish, put them in a glass globe of water and the job is done. They are surprised that after a short time the fish die, and the pleasure (?) of an aquarium is finished! This is a great mistake as I hope to prove.

An aquarium, like all other livestock, needs daily care and attention. At the same time it provides a considerable amount of interest, and is the means of much knowledge being gained of the life habits of its inhabitants.

The first thing to decide when making an aquarium our hobby is the shape it is to be. Large glass globes with rather narrow top openings ought not to be recommended, for one reason one is seldom able to see the fish, etc., in their proper shape, they appear unnatural. Another reason is that these globes do not allow enough air to the surface of the water. The square or oblong ones show up the inmates well, and in their natural form. If all the sides are of glass the two sides and the back should be shaded by a piece of green cloth or pieces of cardboard, as the fish and other livestock prefer this to having the light glaring in on all sides as well as the top. If you cannot afford one of these square aquariums a good aquarium can be made with a large earthenware pan, or a bucket or tub. Be sure that it is

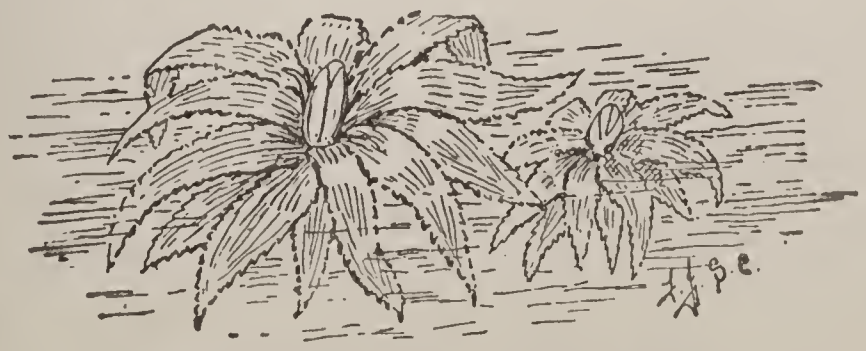
thoroughly cleansed with boiling water, and then well rinsed with fresh water before beginning to stock it.

Having obtained an aquarium it will be necessary to get enough river sand and small stones to cover the bottom, the proportion being three parts of sand to one part of small stones. This will form the bed of the aquarium, the depth being regulated according to the size of the aquarium, but never deeper than two or three inches. Before placing this mixture in the aquarium, it should either be boiled or thoroughly scalded in boiling water in order to kill any fungus or harmful matter.

The next items needed are some plants or water weeds, for in addition to being ornamental and greatly adding to the beauty of the aquarium, they will be a very valuable help in keeping the water right for the following reason. The cause of many fish dying a short time after being put in an aquarium has been the want of oxygen gas. A continual fresh supply of this is needed if the fish are to keep healthy. During their respiration fish give off a quantity of carbonic-acid gas, which needs to be got rid of. It is therefore necessary to have oxygen supplied, and also something to consume the carbonic-acid gas. It was found that water weeds did just what was required, as they need and absorb the carbonic-acid gas, and give off oxygen. After placing some water weed in a glass vessel of clean water, you will, after a time, see little air bubbles continually coming from the leaves and passing through the water, these little air bubbles are composed of oxygen.

One of the best plants for an aquarium is the Water-soldier. This has broad leaves with saw-like edges which bend over from the centre of the plant and remind one of some kinds of Cacti. It is found in ponds and prefers places where the water is quiet, without a current; for this reason it does well in an aquarium. The Anacharis, commonly called Water-thyme, which originally came from Canada, is very common in rivers and streams in all parts of the country, in fact it is too common, as if it were not cleared continually it would soon choke up many rivers and streams. It flourishes well in an aquarium and has a nice appearance. The Frog-bit (*Hydrocharis Morsus Ranæ*) is another useful plant, and is not difficult to find. Then there are the Vallisneria which are general favourites; also the Water-starwort, the Water-violet, etc.

After a time you will find that the inside of the glass of your aquarium is becoming covered with a green mucus, which grows thicker each day. This would, in time, prevent you from seeing any of the inmates, and must be got rid of. If you capture from some pond or stream, or buy, two or three water snails, they will act as your window-cleaners by consuming this growth.



The Soldier Plant or Water-soldier

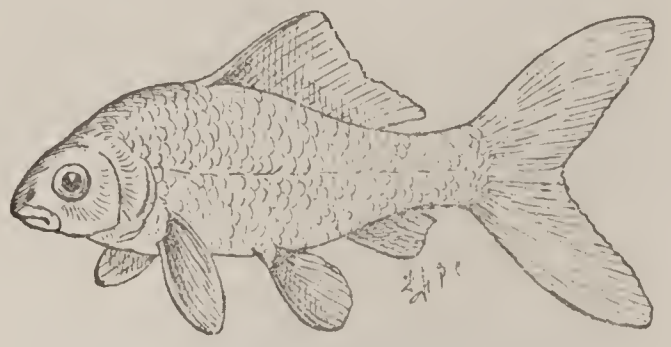
There are the Fresh-water Whelk (*Limnæa stagnalis*), the Trumpet Snail (*Planorbis corneus*), and the fresh-water winkles or snails (*Paludina*). These latter are viviparous, the young being hatched while the eggs remain with the female in the shell until they are able to find their own food and look after themselves.

Now as to the best kinds of fish for our aquarium. The members of the Carp family are very pretty, both as to shape and colour, and do well. The well-known Goldfish is one of them, varying in colour from a pale lemon gold to deep orange gold, then to red. Some are nearly black, and some white, like silver; others have black markings which look very pretty, especially when evenly marked. There are others with extra large fins and tails, some with forked tails and some with fan-tails. There are also the Telescopic goldfish with very prominent eyes, and the goldfish with long drooping tails which look as if they were made of fine silk. The water for these latter, however, must be kept at an even warm temperature. Most of the others are exceedingly hardy, and even in winter time can stand very cold water.

Fan-tailed Goldfish

The Prussian carp looks well in an aquarium, and will live there a long time. Some even become very tame, and both these and the goldfish get to

know their owner and will come to the top of the water and take a little worm from his fingers. To get them to do this you must always attend to them quietly, so that they do not get suddenly frightened. They will then begin to lose all fear of you, and finally come for their food. The common carp needs a larger aquarium than the Prussian carp, as he is much bigger. The common carp has barbels on the lips which the Prussian carp does not possess, and the fins and cheeks are a bright reddish orange colour.



Goldfish, with Large Fins and Tail

The Dace is also a pretty fish for the aquarium, having a nice shape, and being of a very fine, silvery colour. It is a lively fish and darts about very quickly.

The Gudgeon is an interesting subject, and does all right in an aquarium; it has barbels like whiskers on the lips.

Roach look very pretty and bright, but they need a larger aquarium than the other fish mentioned.

One of the prettiest British fishes is the Perch, but it will need to be a small one if it is to be kept in the aquarium with other fish, otherwise you will find

Telescopic Fish

The Miller's Thumb

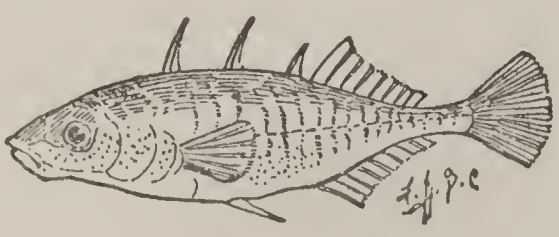
he has eaten some of them. Minnows are good subjects for an aquarium, but they must have the water kept exceedingly fresh, as they prefer a running stream.

The Tench is one of the most suitable fish for an aquarium, as it thrives in still water and does not need the same quantity of oxygen as many other kinds of fish. Of a greenish gold colour, it makes a nice contrast to other fish; its scales are much smaller than those of the carp.

The Miller's Thumb is not a lively specimen. It prefers to remain at the bottom of the water, and is generally to be found under loose stones. Its peculiar shaped head and different mode of life makes it, however, an interesting subject.

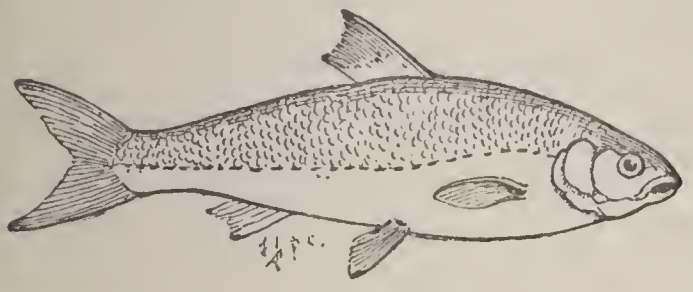
The lively looking little fish, known to most small boys as "Tiddlers," are really Sticklebacks, and remarkably interesting little fish they are too. The males especially are of a brilliant metallic colour, while their mode of living is different from other fish. It is better, however, to keep them in an aquarium by themselves, as they are very pugnacious and can and will kill other fish their own size with the spear-like spines on their backs.

There are four different species of sticklebacks, viz. the Three-spined, Four-spined, Ten-spined, and the Short-spined, the most common being the Three-spined.



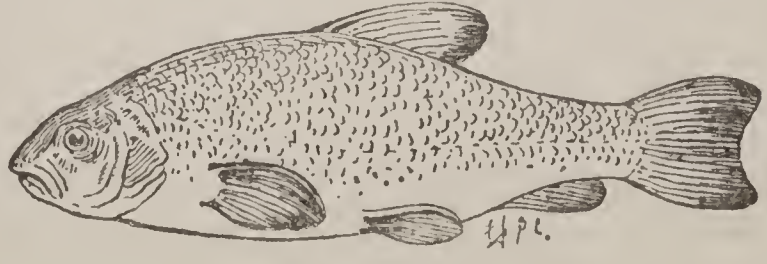
Three-spined Stickleback

An interesting and curious point about these little fish is that the male builds a little nest and watches first over the eggs and then over the young fish, or fry, in a very careful and serious manner, fiercely driving away anything that approaches the nest. The eggs of the stickleback are remarkably large, in fact they are at least twenty times as large as the eggs of the cod fish, and are, therefore, tasty morsels for other fish, and the various inhabitants of a pond or stream. Consequently it is necessary to guard them well, or the race of sticklebacks would very soon become very rare. The nest is made of pieces of decayed water weeds and mud, and built at the bottom of the water. It has two or three round holes in the top of it. Nest building and rearing the young take place during the month of May.



A Dace

Water Newts may also be kept in an aquarium, but they look better if kept in one by themselves. They also need either some pieces of stone that protrude above the surface of the water or a piece of rustic cork which floats on it, as



The Tench

Crested Water Newt

they like to come out of the water occasionally.

Frogs and Toads should not be kept in an aquarium or you will soon find one morning that they have been drowned. They are interesting pets, and should be kept in a case, like a fern case with moss at the bottom, and a deep saucer of water.

The diving-spider is an interesting subject which looks as if it had a ball of quicksilver on its back. It is, however, really fresh air, as these spiders require more air than they can obtain from the water. They are therefore provided with a kind of second skin covering the abdomen and the surrounding parts, and are to be seen continually going to the surface of the water to get this little sack refilled with fresh air. If you put some of these spiders into your aquarium you will find that, unluckily for the spiders, the fish will eat them.

Smooth Newt

Don't feed your fish on bread crumbs or they will not last long. The best food is small earth-worms or blood-worms. These should be placed in wet moss which will clean the worms before giving them to the fish.

ADVANCED PHOTOGRAPHY

GET OFF THE BEATEN TRACK

PHOTOGRAPHY (with the first principles of which it is assumed in this book, every boy is familiar) owes its popularity as a hobby to the wonderful air of mystery which surrounds the after processes of development, etc. It seems so wonderful to place a plate in the camera, make an exposure, and after finding that nothing seems to have happened to it, to be able to bring up the latent image from apparently nowhere. Incidentally to the amateur who has been led to expect wonderful things, it is a great disappointment to find that nothing happens.

Once the technical difficulties are overcome development ceases to be wonderful. One knows that correct exposure and development *must* produce a negative. There was always a delicious doubt in the novitiate stages as to whether this would happen.

With expertness, the interest in the hobby is apt to wane. When this occurs, immediately try to get out of the rut. Take something new; something out of the ordinary; specialize in some particular subject.

Attempt the most difficult subjects—the more impossible the better. The one or two successes will give more satisfaction than countless snaps made in a good light.

SNOW PHOTOGRAPHY AT NIGHT

The above is a subjeet whieh will give most interesting pietures, and be different to the ordinary album print.

As there is not suffieient light to reeord snow at night, one must take advantage of artifieial illumination, sueh as street lamps, or the lights on buildings. In large towns where are lamps abound, very good pietures may be made by photographing a street covered with snow, and aetually ineluding the source of illumination in the pieture. Baeked plates are essential, and flare spots must be avoided by suitably shading the lens. With two are lamps about fifty yards away from the eamera, I have made sueeessful pietures, fully exposed, with an exposure of five minutes at F/8.

With ordinary gas lamps, the exposure will run into fifteen minutes. Care must be taken to keep snow from falling or blowing on to the lens, and any moving lights near the eamera must be notieed. When these eome into range of the view, hold the hand close to the lens until they have passed, otherwise they will reeord themselves on the negative as blaek lines.

Magnesium ribbon ean be used for eountry seenes, in woods, ete. Three feet of ribbon are required for a well-exposed negative with a stop or aperture working at F/8. When working for close-up views, sueh as trees eovered with snow near the eamera, it is advisable to eut the ribbon into two pieees, burning one behind the camera, and the other well to the side. This will avoid the flat lighting whieh

Facing page 232.

"Burglars!"

Photos: Clarence Ponting

"Black Magic"

THE FINE ART OF PHOTOGRAPHY

Facing page 233.

Fig. 1

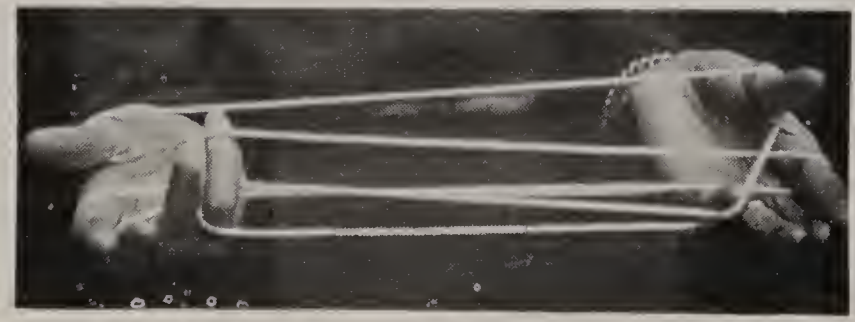


Fig. 2

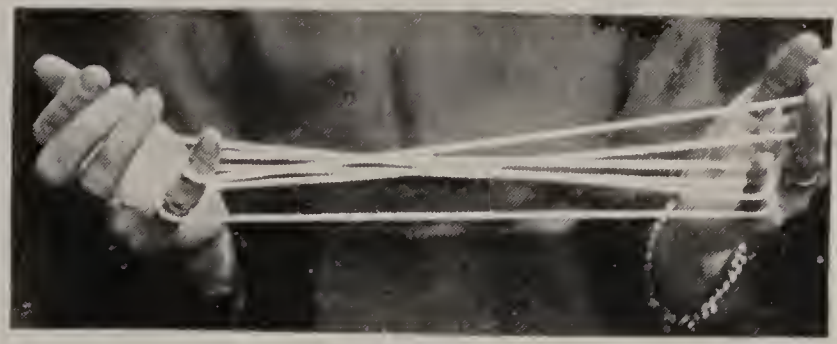


Fig. 3

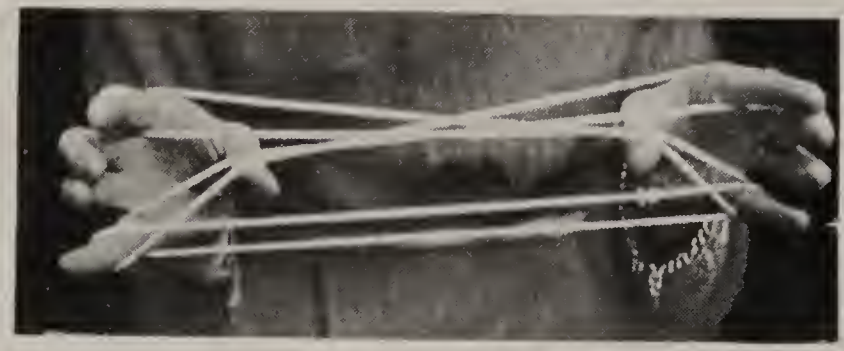


Fig. 4

Fig. 5

Fig. 6

TRICKS WITH STRING *See page 247.*

would result if the magnesium was all ignited behind the camera. A little observation will enable some very fine pictures to be taken, if one takes advantage of the strong shadows which will be cast by the burning wire.

SEASHORE PICTURES

One of the things which the inland photographer never seems to realize, is the additional light which is present on the beach. This is due to reflection from sand and sea, and admits of very much quicker exposures than he is used to giving. Unless the camera is one of the cheap ones which has an aperture of F/11, over exposure will fall to the lot of the unthinking. With large aperture lenses, one must do one of two things: either stop down, or drive the shutter at a higher speed. Open beach work such as breaking waves, sunsets over the sea, and distant shipping studies, call for the highest speed, or smallest stop of all. During the usual holiday months, between the hours of ten and five o'clock, an open beach view should have about $\frac{1}{100}$ second at F/11. if the sun is fairly bright. Even with an obscured sun, instantaneous exposures up to $\frac{1}{50}$ are quite possible at F/8. On account of the actinic power of the light, use may be made of a pale yellow screen for shutter work, which would be quite impossible inland. The better rendering of the sands, water, and blue sky which is obtained when a screen is in position, should be remembered. A good exposure meter will save its cost in plates at the seaside. Colour sensitive plates, backed for preference, should be used.

PRINTING IN A FIGURE FROM A SEPARATE NEGATIVE

First seleet the landseape negative from which the finished picture will be made. Then deeide upon the one containing the figure. Care must be taken to see that it is eorreetly lighted in relation to the landseape negative, and that the figure is of the right size for insertion. In most cases, the figure will have to be specially posed in the required lighting, and may be taken of the exact size required to fit the position which it has to oceupy in the landscape. If this is not eorrect, the proportion will be wrong and the introduetion apparent to everyone.

The figure is earefully bloeked out from the rest of the negative, by means of opaque water-eolour. Fig. 1 is a print from a negative showing how the figure is isolated from its surroundings. A hole smaller than the white oval is eut out of a piece of black paper, and plaeed on the glass side of the negative so that only the figure ean print through the hole, the rest being white unprinted sensitive paper. As the figure is still capable of being printed upon, it must be proteeted from light aetion by painting over with an opaque water-eolour. This should be done under a reading glass, as a slip over the outline will cause a white mark to show.

When the paint is quite dry, plaee the landscape negative Fig. 2 in the frame, adjust the paper so that the paint-protected figure eomes in the eorreet position, then print to required depth in daylight. The paint is removed in the hypo solution when

fixing the print. Gelatino-chloride P.O.P. is not suitable for this method. The result will be seen in Fig. 3.

INTENSIFYING NEGATIVES BY THE SULPHIDE FORMULA

There are such a number of chemical compounds at present on the market for the intensification of negatives, that the beginner will be somewhat doubtful as to which he should use. Provided one tones bromide prints by the sulphide of sodium method, the matter is already decided, for the bleacher will act very well as a negative intensifier. This bleacher and blackening solution may be purchased ready prepared at almost any photographic chemist's. It is sold for the purpose of toning prints on bromide paper to a very nice sepia tone. Intensification of a negative is obtained by a change in the colour of the image, rather than an actual increase in the density of the deposit. Like all other solutions, it is cheaper to prepare than to purchase ready-made. It will keep almost indefinitely in well-corked bottles.

Bleaching solution is made of potassium ferri-cyanide, 80 grains ; potassium bromide, 160 grains ; hot water, 8 ounces. The negative is placed in this solution until it assumes an even buff tone, which stage is reached in about one minute. Wash after removal from this bath, for a few minutes, until the yellow solution has left the negative. Then, immerse in the blackening solution until the image will blacken no further. Usually takes about one minute. Wash for five minutes, and negative will

be found to give a much better print than it did previously. Negatives which might be described as " flat " rather than " thin," benefit most from this treatment.

CLOUDS AND LANDSCAPE ON THE SAME PLATE

At some time or other every photographer has seen a view in which the sky made the picture, and wished that it was possible for the camera to record sky and view on the same plate.

The sky portion of the picture receives about ten times more light than the landscape. Working on this fact, it is easy to control more or less the quantity of light which reaches the plate from that portion representing the sky, by means of what is known as a graduated screen. With such a screen adjusted on the lens, it is quite easy to retain any clouds which may be present on the same negative as the landscape over which they float.

A graduated screen is made by first fixing out two lantern plates, washing and drying. Then prepare a dye solution by dissolving one deep yellow Velox colour stamp in one ounce of water. A book of colour stamps may be obtained at almost any chemist's. Take one of the fixed and dried lantern plates and immerse it in the dye solution until one inch of the film is covered. Leave for three minutes. Do the same to the second plate, allowing it to go half an inch farther into the dye than the first plate. Without washing, pick the plates out of the dye, taking care none of the dye runs over the clear portion of the film, and allow

to dry. When dry, place the two dyed portions film to film, and bind up in the same way as when binding a lantern slide. The screen will now be almost half yellow and half clear. The yellow portion is used to keep back the clouds, whilst the clear portion allows the light to pass unobstructed to the plate from the landscape portion.

The filter must be adjusted in front of the lens so that only the yellow portion covers the sky. Slight overlapping is permissible, but it *must* be slight. Some simple form of holder may be devised to keep the screen on the lens, but I find two strong elastic bands work quite well on my roller-blind shutter.

PHOTOGRAPHY FOR COMPETITIONS

From time to time, with the idea of obtaining good examples of work produced on their products, manufacturers of photographic materials organize competitions in which very valuable money prizes are offered. These competitions are absolutely genuine, and the prizes are actually awarded to amateur photographers. Any amateur who can turn out clean, bright, technical negatives, stands a good chance of winning a prize, and a still better one if he can combine the pictorial with technical excellence. The use to which the prize giver will put the prints from the winning negatives, is for show-card purposes. He wants some negatives of striking and arresting subjects which will catch a photographer's eye as he hurries past the dealer's shop window. If you can supply such negatives, then by all means enter them for competition.

A careful study of the rules is advised, as every manufacturer alters them in some slight degree. Having found the class in which you think you may score, make an attempt to get a picture specially for that class. Do not depend upon one which you have already made. You can fall back upon that if you can't get something better. When I am working for a competition, I usually find that the last exposure is better than all the previous ones. Take pains with the prints in the matter of mounting and spotting. Get them ready well ahead of time, so that the work will not be rushed at the last moment. Pack between stiff strawboards; for nothing looks worse than a damaged mount or print. Attend to such matters as return postage (or wrappers if stated), closing date, etc.

SELLING PRINTS TO THE PRESS

The camera can be made to recoup some of the heavy outlay necessary to practise the hobby, by the sale of prints to the Press. By "Press," one means daily newspapers, weekly illustrateds, weekly magazines, monthly illustrated magazines, and the sporting press. Nowadays, provided the subject is what an editor requires, it is no bar to publication because the photograph is the work of an amateur.

But so many amateurs have the little knowledge of the subject which makes it a dangerous thing. They do not pause to consider the needs of the journal, and submit unsuitable prints to one and all. This method results in a fine crop of rejected matter. All newspapers and most of the weekly illustrated

press, have a staff of expert photographers who "cover" any matter required by the paper. The amateur can rest assured that a photograph of any well-known event will be the work of a staff man. The editor is glad to use amateurs' work of subjects which it would be too expensive for his staff men to cover. Thus, if a well-known race-horse died in your district, and you were enterprising enough to make a photograph of it *and submitted it to the journal the same day as the horse died*, it would probably be used. But if you sent it up a day later, it would be old news. The editor would, in the meantime, have made use of a picture of the living horse, and no matter how good your photograph of the dead one, he would turn it down. With the daily Press, speed is everything. If you get a unique picture, let the editor know it is coming. Wire if necessary. Do not even trouble to develop. Pack it up in a box and send the plate by rail. The paper will develop it on arrival, and may sell the prints to a dozen other journals, each of whom would pay a reproduction fee. Pack in a wooden box to avoid breakage. The editor will not take any more of your stuff if a negative for which he has saved space arrives broken.

AN EASY METHOD OF BACKING PLATES

There is no need to dilate upon the advantages of the backed plate. It is so great that a keen worker will pay good money to obtain plates ready backed. By making one's own plate backing and applying it at home there is no reason why anyone should risk halation.

The backing is made of the following materials and proportions. Into an old tin or saueepan plaee one pound of common brown sugar and pour on sufficient water to just cover it. Place on a good red fire and boil until smoke begins to rise. Remove and pour in a tumbler of cold water. The mass will immediately splutter and set hard.

Again place on the fire, and when liquid pour in one pound of burnt sienna. Then boil until mixture beeomes as thick as treacle. When nearly cool, pour in half a pint of methylated spirit, stirring the whole time. Pour into a wide-mouthed pickle jar and tie down.

There are several ways of applying the backing to the glass side of the plate, but the two best are with a small pieee of sponge soaked with the baeking, and a roller squeegee.

The plate is placed film down on the page of an old magazine, and the paeking applied by rubbing with the soaked sponge. A fresh page is used for eaeh plate. A more satisfaetory method is to pour out a small pool of the baeking on to a spoiled negative, roll the squeegee in it until evenly coated, then roll it on the plate whieh has been laid film down on the magazine page. This puts a thin even coating which will dry quickly. If dark slides are used, the plates may be inserted wet. This baeking does not flake off and eause pinholes. Use plenty of red light to avoid getting the backing on the film, and roll the squeegee first up and then across the plate. There is no danger of slipping, and the hands do not beeome soiled by the squeegee method of application.

NOTES ON GARDEN PHOTOGRAPHY

Any notes on this subject must be more or less general, as a garden contains so much that is photographable. Some may like to photograph specimen plants, whilst others may amuse themselves by photographing a plant in a series of exposures to illustrate from seed to fruit. Others find a garden photographically interesting from the creepy things they can find in it. Pictures of these and the damage they cause are purchased for reproduction in garden papers. The pay is small, being only five shillings for each print.

Each one to his taste, but when making prints for sale of garden subjects give me a small cottage garden to work in. Here one can find groupings of pinks, poppies, sweet peas, rosemary, and lavender, growing in pictorial disarray. Although common flowers growing in humble surroundings, they lend themselves admirably as a setting for a figure study; or even by themselves will produce a pretty photograph.

In the small cottage garden the garden photographer will find his subjects. The garden which is attended by a head gardener and underlings is too large for pretty work.

This class of subject, on account of the multitude of various coloured flowers, should be photographed on either panchromatic plates or with ortho plates and a yellow screen, increasing the exposure some six times. Early morning and towards sunset will be found to be the best times, as advantage is gained from the long cast shadows, which usefully fill up

large uninteresting spaces sueh as lawns or gravel walks.

Spring is not a good time for garden photographs, the beds being filled in most eases with forget-me-nots and wallflowers ; both of whieh photograph in a most disappointing manner.

In early spring, daffodils make many a pieee of woodland garden very pretty. To reeord these or any other yellow flowers, an ortho plate is essential and a by six screen *must* be used.

THE PHOTOGRAPHY OF SNOW

Those who took my advice at the eommeneement of these somewhat rambling notes and are on the look out for diffieult subjeets should not pass the photography of snow on one side. It is *the* most diffieult subjeet to render eorreetly next to that of sunlight. Like objeets in strong sunshine, the photographer is dealing with a subjeet eontaining extremes of eontrast. Snow is dead white, and the sky after a fall is very often blue. Unless care is exereised, blue and white will eome out in a photograph with very little differenee in the eolour rendering. It is on the eorreetness of this eolour rendering that the whole sueeess of snow photography stands or falls. Though snow may seem white to the eye, the amount of blue light whieh is refleeted from it is unbelievable. This is more espeeially so on a day when the sun is shining brightly. Notiee partieularly the shadows the next time a fall of snow oeeurs. To your surprise you will find them quite blue.

As snow is only worth picturing when the sun

is casting these shadows, some pains should be made to ensure the correct rendering of these shadows, as well as the texture of the snow. Everywhere the snow is reflecting light on a sunny day, which means that exposures on unscreened plates must be brief. Orthochromatic plates are vital to success, and should be used in conjunction with a by six yellow screen. With such a screen and a rapid plate, it is possible to give a shutter exposure of $\frac{1}{25}$ second at F/8 providing the sun is not too near setting. In this case the exposure may run into one or two seconds. It is a class of subject which warrants the purchase of an exposure meter. Prints either on blue carbon or bromide toned blue are most effective for snow pictures.

CANDLE-LIGHT EFFECTS BY DAYLIGHT

A very pleasant way of spending a dull winter afternoon, and one in which the photographer with original ideas may score, is that of making candle-light pictures. The subject lends itself to striking pictures, provided the worker can think of suitable ideas. The first which would naturally come to one is that of burglars. The trembling spinster or old lady clutching a revolver whilst she peers affrighted into the flickering light cast by her candle!

Naturally, the light of the candle is too weak for serious illumination, yet is strong enough to record the flame in a matter of seconds. The candle in the illustration entitled "Burglars!" is from an untouched negative which received only two seconds' exposure.

As the candle gives too weak an illumination, it must be supplemented by daylight. The photograph "Burglars!" was made by placing the figure near a window, roughly posing, in order to get the focus, and then told to rest. The background was a dark cloth pinned against the wall. The window was then blocked up with two thick curtains until only a slit was left in the middle some three inches wide. This only allowed a thin beam of light to enter the room, the rest being in darkness. The figure was then told to regain her pose, the candle lighted, and at full aperture of F/6 on a plate speed H. and D. 200, received two seconds exposure. On no account force development, or the finer details in the high lights will be choked up. Develop for the high lights alone, and let the shadows look after themselves. If the lighting is properly managed, the picture will practically consist of high lights.

The model chosen should have a steady hand. It is not so easy as it looks to hold a lighted candle for two seconds without making any movement of the flame. Should it do so, a double image is almost certain to appear in the result.

STUNT LIGHTINGS BY COMBINING MAGNESIUM WITH DAYLIGHT

A variation of the above idea can be obtained by substituting magnesium ribbon or wire for the candle. The brighter illuminant enables some striking lightings to be obtained, but as magnesium by itself is apt to give rather harsh lightings, daylight can, with advantage, be combined with it. This enables

the exposures to be cut down considerably. It is rather surprising that photographers have not done more with the combined magnesium and daylight lighting. At the Christmas party some good pictures will no doubt suggest themselves to the imaginative. The magnesium light can be controlled, and as it will burn in almost any receptacle is a very useful light to have at a party or amateur theatricals.

For most subjects, the same arrangement of window curtains and background will be necessary. In the illustration "Black Magic," the magnesium ribbon used measured three inches, and was held in position in the bowl by being stuck into a piece of potato. The curtained window admitted the same shaft of light as when the candle picture was taken. As magnesium fumes very much, it is better to choose a pose where the model can keep the head away from the smoke. There is no need to keep the lens open during the whole time that the magnesium is burning. One second was the exposure for the accompanying illustration, under the same conditions as the candle one. In this case the smoke which rose from the burning ribbon was an advantage, but it can be a nuisance. It will record if too much daylight is admitted. For this reason the slit between the curtains should never exceed three inches. Negatives should be kept thin in development, and as in candle-light pictures, the high lights are the things to judge the density by. Prints may be stained yellow or red after they are fixed and washed, when they become very effective and help to carry out the idea. Photo dyes of suitable colours are sold in tabloid form.

HOW A BROKEN NEGATIVE WAS SAVED

At some time or other a minor fraeture is sure to occur which, although small, is suffieient to ruin the negative. Sometimes it can be saved, as in the present instanee. This negative had the top right hand corner broken off, as shown in Fig. 1.

The first thing whieh was done was to block out the sky and a portion of the balcony, which altered the line of the architeeture somewhat. A print from the negative in this condition is then taken on P.O.P. and will be as in Fig. 2. It should not be fixed or toned, for after the white sky portion is cut away, the remainder is allowed to blaeken in the sun, and forms the mask whieh protects the already printed portion when inserting the new background.

The print from the blocked-out negative has a white unprinted portion above the baleony, which is capable of taking the image of any suitable background negative. As, however, the already printed balcony is still sensitive, it must be prevented from printing by means of a mask deseribed above. Any irregularities of masking ean be matched on the print when dry, with water-colour.

Now take a print from the blocked-out negative, and adjust the baekground negative on the white unprinted portion, eovering the already printed portion with the mask, whieh is lightly fastened to the glass side of the baekground negative with a toueh of paste. Print in a shady plaee, as the sun gives too hard a line to the mask. The result of the union is seen in Fig. 3. The lighting of the baekground negative should be similar to that of the subjeet negative.

TRICKS WITH STRING

I HAVE often wondered who was the first to invent string tricks. Probably it was some savage man who obtained his living by fishing and who whiled away his leisure moments by playing with the line upon which he depended for his means of subsistence. However that may be, tricks of all kinds have a strange attraction for old and young, and most boys have spent many an hour endeavouring to solve some puzzle which had been given to them, or to do some new trick which they had been shown.

String tricks have always had a fascination for me, and I have during a course of years become acquainted with a considerable number. I therefore propose to describe the manner of doing some of them, as I am sure they will prove of interest to my boy readers. The tricks are all very simple; but, nevertheless, they look very effective when shown to others; and when you have learned them I am sure you will find amusement for yourselves and be able to entertain your friends in working them out.

A very good trick indeed is one known as "slip cradle." It is executed thus. Take a piece of string about four or five feet long, and tie the ends together so as to form an endless loop. Then take the string upon the thumbs and little fingers of both hands. Now pick up the string which crosses the palm of the left hand with the back of the first finger of the right hand; and pick up the string which crosses the palm of the right hand with the back

of the first finger of the left hand. Separate the two hands, and you have the "cat's cradle."

Next bring the tips of the fingers together, and see that the fingers are pointing towards the friend to whom you are showing the trick. You will now find that there is a string hanging over the backs of your thumbs. Tell your friend to take this string and pull it towards him. He will do so, and will be surprised to find that the string can be pulled right off your hands without your having to separate your fingers.

The next trick is also very simple, but it is no less effective than the one just described.

Place the string so that the loop is round the inside of the first and middle fingers of the left hand, with the double string hanging down the back of the hand. Then bring the end up and slip it under the loop on the fingers, when the string will be hanging down the palm of the hand. Be sure to see that the double string which is between these two fingers passes *underneath* the string which binds the two fingers together. See also that the two strings which hang down between the fingers are not crossed. Now insert the left thumb between these two strings by putting it over the string which is closest to it and beneath the far string. Bring the tips of the first finger and thumb together, and, by lifting the loop of the middle finger, and by pulling the hanging down loop, the string will come off the hand.

The next trick is known as "cutting your head off." To do this trick it is better to have the string somewhat longer, say six or seven feet. Tie the ends together to form an endless loop as before.

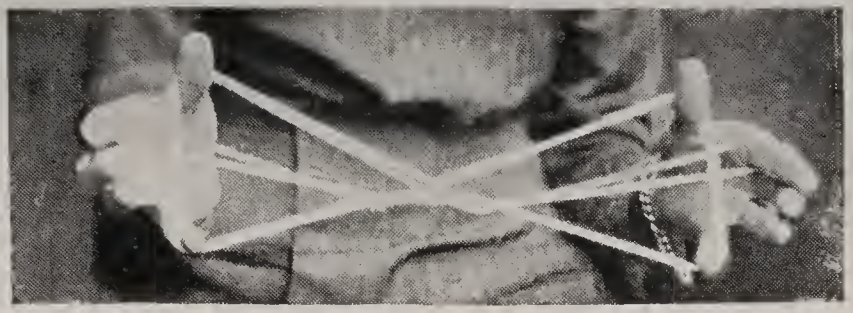


Fig. 7

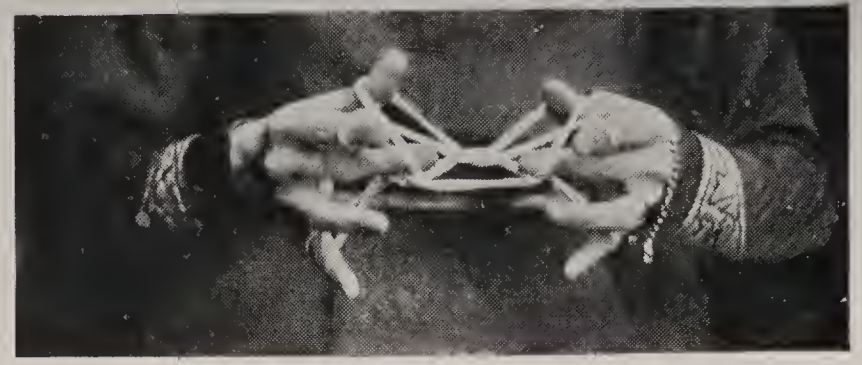


Fig. 12

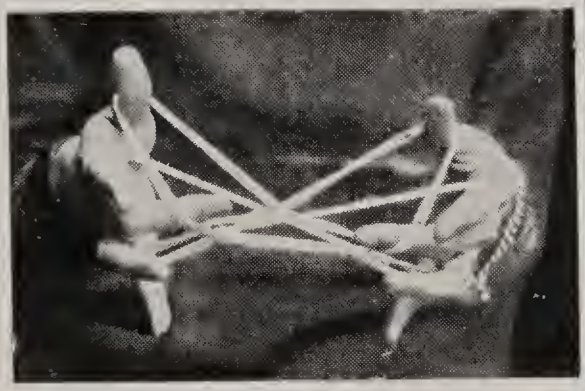


Fig. 9

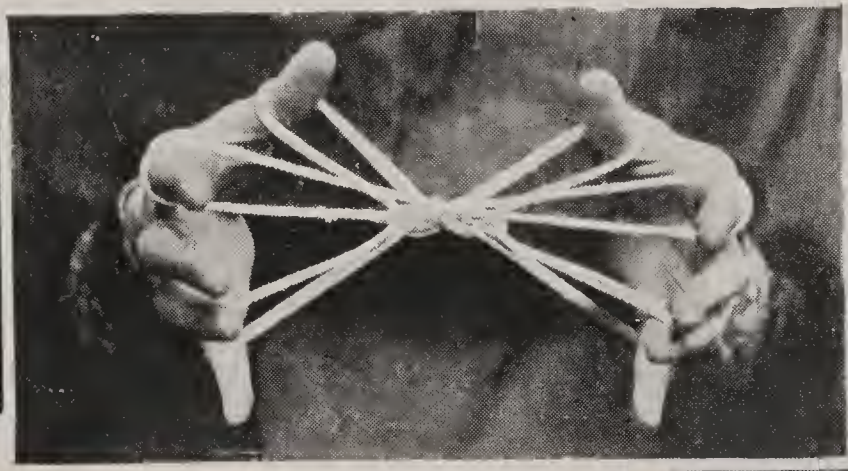


Fig. 8

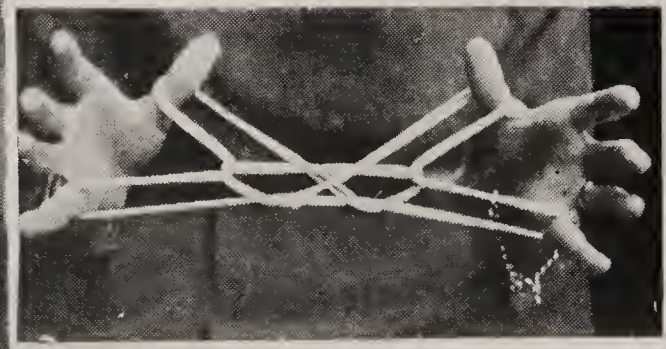


Fig. 10

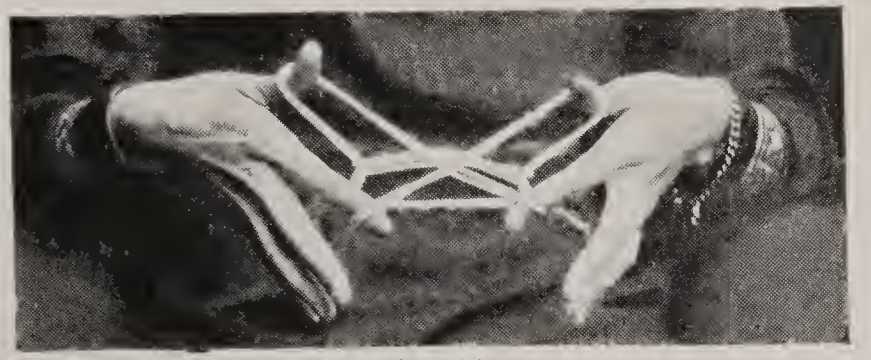


Fig. 11

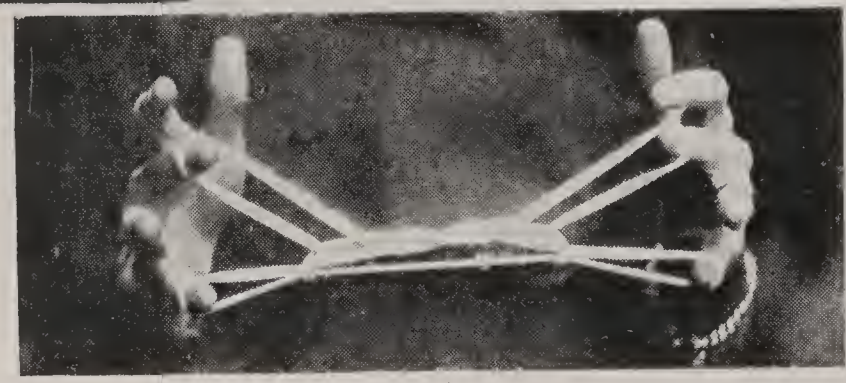


Fig. 13

Fig. 14

Fig. 15

Fig. 16

Fig. 17

Fig. 18

Fig. 19

TRICKS WITH STRING

Facing page 249.

Now hang the double string around your neck, pulling it tight by inserting one thumb of each hand in each of the loops that have been formed by the double ends of the string. Now hook the little finger of the right hand around one of the strings of the left thumb-loop, and hook the left little finger around one of the strings of the right thumb-loop, so as to pull open both of the loops.

You will now find that by allowing the string to slip off the right thumb and the left little finger and separating the hands quickly, the string can be made to appear to pass right through the neck. It will then be hanging loose upon the hands. This trick should always, of course, be done very quickly, but the action of letting the string slip off the thumb and little finger is very easily mastered, and after one or two trials you should be able to do it so rapidly that not even the most observant of your friends could readily detect "how it is done."

For the Sunset Cat's Cradle—this is the title by which the next trick is known amongst the Apache Indians of North America—you will need a piece of string about seven or eight feet in length. Tie or splice the ends neatly together so as to form an endless loop. Take this loop upon the fingers and thumbs of both hands, that is, put the string behind the thumbs and across the palms to behind the little finger, so that the string hangs loosely down in front of you.

With the back of the first finger of the right hand pick up the string which crosses the palm of the left hand, and with the back of the first finger of

the left hand pick up the string which crosses the palm of the right hand.

Separate the hands, and the string will be shown as in Fig. 1.

Bend the little fingers of each hand towards the body over all the fingers' strings, and insert them underneath the inside strings of the thumb loops (Fig. 2).

Bring the little fingers back to their original positions so that the thumb loops are lifted entirely off the thumbs and transferred to the little fingers. You now have Fig. 3.

In the centre of this figure you will see a large triangle, the base of which is formed by two strings passing from one little finger to the other, and the sides of which are formed by double strings passing from the first fingers to the little fingers. With the backs of the thumbs pick up each of these double sides, as in Fig. 4, and bring the thumbs back to their original position, under the first-finger loops, which will give Fig. 5. Release the loops from the little fingers and extend to obtain Fig. 6.

Bend the little fingers towards the body over both the first-finger strings, and with the backs of the little fingers pick up the double inside strings of the thumb loops, and bring the fingers back to their original position (Fig. 7).

Exchange the first-finger loops by transferring the loop which is on the right first finger to the left first finger, and by placing the loop which is on the left first finger upon the right first finger ; thus one loop will pass through the other.

Extend the hands, and you will obtain Fig. 8.

You now have two loops on eaeh thumb, one loop on eaeh first finger, and two loops on each little finger.

Now, with the baeks of the *middle* fingers, pick up, *through* the first-finger loops, the double inside strings of the thumb loops, as in Fig. 9. Allow the thumb loops to slip off the thumbs and the first-finger loops to slip off the first fingers ; then transfer the middle finger loops to the thumbs to obtain Fig. 10.

In the centre of the base of this figure will be seen a small triangle. Pick up the sides of this triangle with the baeks of the first fingers (Fig. 11), and bring the first fingers baek to their original position. The first fingers will now have loops upon them.

With the baeks of the middle fingers piek up *through* the first-finger loops the inside double strings of the thumb loops, whieh will give Fig. 12.

Release the thumb and first-finger loops, and extend to obtain Fig. 13.

The resemblanee to the eonventional representation of a setting sun is very striking.

The last trick is a little more eomplieated, but it is one of the prettiest tricks known to me. It is known as a " hand-slip." Whether or not it has any distinctive name of its own, I do not know. Probably it has ; for many of these trieks are world-wide and have been given names by whieh they may be distinguished. This partieular trick I learned a good many years ago, whilst at school ; but, strange to say, I have never met anyone else who could do it.

For this trick use the shorter of the two loops. Hang the string on the left hand, as shown in Fig. 14. See that the hanging-down loop is over the string which crosses the palm of the hand. Now, without twisting the strings, place the hanging-down loop behind the left thumb, as shown in Fig. 15. There are now two strings behind the left thumb—an upper and a lower. Bring both strings down to the front, or palmar side, of the hand, and twist the upper string around the left first finger from right to left, as shown in Fig. 16. Next put the lower thumb-string between the ring finger and little finger, being careful to see that this string comes *underneath* the upper first-finger string (that is, the string which you have just twisted around the first finger). Your hand should now appear as in Fig. 17.

Take the two loops off the thumb, as in Fig. 18, and place them between the two middle fingers, as shown in Fig. 19, clipping them fast between these fingers.

You will now find that by pulling the string which crosses the palm of the hand the string will come freely away.

In working these tricks any kind of string can, of course, be used; but silk cord, owing to its softness, can be much more easily manipulated than ordinary string.

YOUR DOG, YOUR CHUM

HOW TO CHOOSE HIM AND HOW TO TREAT HIM

WHAT boy, and certainly what British boy, has not longed to have a dog? The dog, man's faithful friend for countless generations, is a most lovable creature, and his affectionate ways, his appealing look, his loyalty to his master, his wonderful instinct and intelligence, his joy at accompanying one on a walk, his protective powers, and his readiness to learn tricks, put him at the head of the brute creation.

And does it very much matter what kind of a dog he is? Not greatly. Each to his fancy. Some will like a big fellow such as the Great Dane or the Mastiff, others will go to the opposite extreme and cherish a King Charles' Spaniel, a Pekinese, or a Toy Terrier, while the sleek coated Collie and the swift Greyhound have their champions.

But in the main the handiest type of tyke is something in the nature of a Terrier, hardy, easily housed, fed and washed. Be he a mongrel or a chap with lordly pedigree he can be a real pal. The matter of his breeding is the difference between shillings and pounds, and naturally, one likes, if possible, to select the best—something good to look at, an aristocrat with "points" fit to win prizes at the local show.

Anyhow, get your pet when he is a puppy of from four to six months old, and get an elder

friend's advice when you go to make your selection. Probably the most fancied of dogs in Great Britain are the smooth and rough-haired Fox Terriers, knock-abouts ready for any sport, game to a degree in wood or water. Of course, there are Scotch, Welsh and Irish terriers, each materially differing from the others; while of larger types there are the Airedale, a grand animal when grown but a clumsy, floppy pup and likely to get you into trouble at home for, like all youngsters, he is destructive and has great strength of jaw and legs. The Bull Terrier is a rarer breed these days and so is the short-limbed, knowing little Sealyham.

Now, let us suppose you decide upon a Fox Terrier. Whether he be smooth or wire-coated is purely a matter of taste. For my part I fancy the rough coated, who is the very essence of smartness when he is properly groomed.

As a lover of animals, let me say at once, do not keep a dog unless you can do it properly. Do not have him in a small house where he may be kicked and cuffed by all who do not want him, and regard him as a nuisance. Further, he must have a place to run and frolic in, and for that matter, to meet his chums. Even if there be a fight it is in congenial company.

Never neglect your pet and be sure he has sound food, plenty of fresh water, and lots of gallops either with you or on his own account. It does not matter whether the dog be a mastiff or a Toy Terrier, his health demands ample exercise off the lead.

On the other hand never take a short-legged or heavy-bodied dog for a long run behind your bicycle

or any horse-drawn vehicle. Of course, to follow a motor-car would be impossible.

Again, I must warn all dog keepers not to chain a dog up for hours at a time. To rob him of his freedom is to make him dangerous and ill. Excessive chaining up can be regarded as cruelty by an officer of the Royal Society for the Prevention of Cruelty to Animals, and may lead to a police-court summons.

Now, an all-important point is the private, particular home of your pal. If he is a house dog to live in, have a suitably sized box or basket for him in some out-of-the-way corner. The bed should be a stout mat, and this should be shaken every day and thoroughly cleaned and sun-dried from time to time. An animal living in the house at nights will have to be taught manners, but do not thrash him for early misdemeanours. To beat and bully is to bring up a permanently frightened, cowering creature. The training can be done by kindness, and, indeed, must be, if you want a chum.

The better plan is to have a well-constructed kennel outdoors in some sheltered spot. The opening to the kennel should face south-west in winter and north-east in summer. Never place a kennel on the ground; always raise it well away, half a dozen bricks being good supports. Do not forget to keep your dog's home sweet and clean, otherwise his health and coat will suffer. If possible, choose a sunny day for the house cleaning so that the scrubbed wood may dry naturally.

Food is a most essential point. Do not think that any old leavings from the kitchen table are sufficient. They are not. Bad food makes a bad

dog. Raw meat is desirable only in very small quantities. Cooked liver now and again, cooked vegetables, some large hard bones and plenty of dry biscuits may be recommended. Be sure not to over feed. A dog having a deal of exercise in the fields will require more nourishment than the house dog. A big bone is a great joy and of real health value, but do not give such small bones as those of rabbits and fowls, as the splintered portions are likely to cut the gums and may be easily swallowed to cause internal trouble. Plenty of fresh water must, absolutely must, be always within a dog's reach.

If you want your pet to look his best and be a credit to you, pay regular attention to his coat. Wash every bit of him except his eyes, give him a thorough good grooming, and be sure that his collar does not cut his flesh or rub his fur.

Follow these simple rules, backed up by kindly and intelligent training, and you will have a real friend for many years. Do not forget that for any dog over six months old a licence, costing seven shillings and sixpence a year, must be obtained.

RUNNING A MAGAZINE

EDITING and publishing a magazine, for your class or school or club, is great fun; but there is a good deal of really hard work connected with it, and, unless you love writing and editing and managing, you had better think twice before you take on such a job.

There are fellows, many of them, who are never happier than when they are writing articles or stories, and for them there is no finer hobby than turning out a magazine, regularly, month by month or quarter by quarter. It teaches them, too. Some of our most famous writers have begun by contributing to or editing a school magazine.

If you really love the game you will probably make a success of it no matter what are your difficulties. In a certain Surrey school there was a Fourth former who brought out, at irregular intervals, a journal which he called "The Waffler." Only a single copy appeared each time, and he wrote it all out by hand and illustrated it himself. His chums paid him a halfpenny per issue to have it for two days each, and a great success it was. It was really funny. He stopped it when his subscribers got to be so many that his single copy was torn to tatters before they had all seen it. Then the school authorities thought they would publish a proper magazine—a printed one—each term. It is very good; but the old subscribers to "The Waffler" still sigh for its merry and bright pages. The printed magazine does not

give them nearly so many laughs, and it is far more expensive.

Now, that gives you some hints if you are thinking of starting a magazine. Give your readers what they want, and you are sure to make a success of it. Also you must charge the very smallest subscription you can manage.

The very simplest magazine is like the one just mentioned. Usually it is all written by one boy, and there is only one copy. The next sort is that which is turned out on a "hektograph" or other duplicating apparatus. There may be anything from ten to a hundred copies of such a publication for sale of each issue. After that comes the printed magazine. Some boys have their own printing machine and type; but usually printed magazines are printed by professionals. If you think of printing your own magazine you ought to buy a small book on printing.

But you cannot duplicate or print your magazine until you have your "copy" ready. "Copy" is the name given to the manuscript or typescript that is turned in by the editor or his contributors. What you want to make up your mind about, at the start, is what kind of "stuff" you are going to publish.

If you are starting a class or club magazine your task will be fairly simple. You will have to have a certain amount of news and comments on the month's doings. Remember that most fellows like to see their names in print, and that the more names you can get into each issue the more popular your efforts will be. Fun you must have, and here you will have to be careful. Be witty—but don't be rude. About some

of your chums and friends you can say what you like. Others will punch your head if you refer to the colour of their hair or the fact that they are "pin-toed." It is undignificd for an editor to have his head punched, besides being painful. Be careful! If you are in doubt, it is just as well to show a fellow what you propose to say about him before you publish it.

Articles about games and training and things like that always go down well, if they are writtcn by someone who knows what he is talking about. A school magazine can often get some excellent stuff of this sort from the masters or team captains. Criticisms of games are oftcn useful in helping the teams to win. Tompkins will think a good deal if he sees something like the following: "Tompkins played an excellent game against West Housc; but he should remember that there are others in the team. Passing is as much part of the game as shooting." Similarly Judson may be waked up by a gentle jest of this sort: "Judson should havc held that catch. What were you doing, Juddy? Thinking about your tea, or trying to make 'silly point' sillier than its name?" A magazine, properly run, exercises a tremendous influence in school or club life.

Most youthful editors find a great difficulty in getting others to send in stuff for publication. Of course everything is "free, gratis, and for nothing," so that the only reward a fellow gets is seeing his stuff in print, and hearing the others telling him what a silly ass he is to have writtcn it. Make up your mind, however, from the start, if you do get copy sent you, never to put anything in just to "fill space, or to save yourself trouble." Always have enough good things

by you to fill your magazine from cover to cover, even if you have to write every single word of it yourself.

You will find that quite a number of fellows will think that they have a heaven-sent mission to write poetry. Don't encourage them. Unless verse is really smart nobody wants it. Be very shy of "serious" verse. Funny stuff that is really funny always goes down well. If any of your readers want serious poetry they can find heaps and heaps of it in the library, and it won't occupy any of your precious space and make most of your readers curl up and die—or come and demand their money back, which is worse.

Fiction, too, you had better fight shy of, unless you are clever at it yourself, or have someone on your "staff" who can sling a good yarn. In class or school or club magazines there are, usually, not sufficient pages to contain a good story as well as all the other stuff that *must* go in. You can seldom get a good yarn under about 2,500 words; 4,000 words is nearer the mark. It is not much use publishing a serial unless you can give at least 3,500 words of it in each issue.

News, and a good deal of fun, with short articles on any subjects that will interest your readers, should be your mainstay. Keep everything as short as possible. In a small magazine a look of good value is given if it is "well broken up" and contains lots of different headings. Remember that solid pages have a "dead" look and will put your readers off. The bigger your pages are the more careful you must be not to let them have a solid look. A glance at any well-

edited magazine or journal—like *Chums* for instance—will show you what this means.

With regard to illustrations. Whether you have illustrations or not will depend on circumstances. In the first place, if you cannot draw yourself you will require the constant and willing services of an artist, if you decide to use pictures. If you are hektographing or duplicating your magazine you will have to have the pictures drawn on the proper paper and with the proper ink. Make your artist keep his drawings as simple as possible. Too much detail will clog up on the duplicating apparatus very quickly. The same advice applies with almost as much force if you are having your magazine printed. In that case you will have to have engravings or " blocks " made of the drawings so that they can be printed. It saves trouble to let your printer have these made for you, if he is a professional. The process of making these blocks is very interesting, but we have no space to describe it here. In any case, it is outside a youngster's powers to make the " blocks " for himself. If your magazine is printed, you can illustrate with photos if you like. These have to be engraved in just the same way as line drawings.

By the way, there was once a school magazine that was turned out in a very ingenious manner. Each page was typewritten, with the necessary drawings made on the sheets. Then the pages were photographed by the school photographic society and printed out just like ordinary photographs. The magazine looked very nice, but it was printed on one side of the paper only, and the paper was thick, so that it was rather bulky when it was bound up. It is

worth thinking about, though, as a good means of printing any number of copies up to, say, fifty, if your subscribers will stand the expense.

So much for general hints as to the kind of things you should aim at having in your magazine. Now for some practical hints about the actual details of editorial work, apart from choosing material.

If you are hektographing or duplicating your journal you can go your own sweet way; but, even then there are some rules you must follow if you would have it look nice and readable. You should, for instance, never start a fresh article in the bottom half of a page, unless it will finish on that page. Again you must be careful that only a few of your articles start on left-hand pages. If anything, articles, etc., starting on right-hand pages should be in the majority. This is particularly necessary when the magazine is small.

If you are having your magazine printed you will probably find that the number of pages you can have will be some multiple of eight. That is to say, you can have eight, sixteen or twenty-four pages or upwards. Most likely, if you wish, you will be able to make up with a four and an eight, so that you can have twelve or twenty pages, or so on. The printer will tell you what you can do without making the job expensive. One thing you cannot do without adding greatly to the expense is to put on an extra two pages.

When you send your copy to the printer it will come back to you, set up, in the form of galley proofs. These are long strips of paper containing a single column of type. When you have galley proofs of all the material you propose to use in the *number* or

issue of your journal you are preparing, you will proceed to "make up." Most editors have their own ideas on the subject of making up the paper; but you will probably find that the best plan is to procure some sheets of paper marked with the exact size of the pages of your magazine. Page these off with numbers to represent the pages of the magazine and remember that odd numbers are always right-hand pages. Now paste each article down in the position you wish it to appear in the magazine when it is printed. You must write in your titles, sub-titles and author's name at the head of the article, showing about how much space you want them to occupy. You must also write in any cross-headings and leave space for them.

If you have estimated the length of each article carefully before you send it to the printer, you will have very little cutting to do. Let your articles be short rather than long. If you have five or six lines too little to fill a page you can always write a short paragraph to fill up, whereas if you have five or six lines too many you will have to pay the printer both for setting them up and for taking them out again.

Make all the necessary corrections on the proofs as you paste them on to the make-up pages and send the make-up to the printer complete in every detail. The printer will send you page proofs after he has had your make-up. These should require very little done to them if you have made up carefully. Read through them to see that all is correct, pin them together, and initial them in the corner with the words "Passed for press" and the date. You have nothing now to do, when you have sent your passed proofs to the printer,

but wait until he delivers you your bundle of nice clean copies.

By the way, don't forget that printers use special signs in correcting proofs. You will find these signs in any encyclopædia, and in such publications as Whitaker's Almanack. If you are in any doubt write what you want done on the side of the proofs—and write clearly.

If you are running a magazine just for your school, class or club you will probably not have much difficulty in getting subscribers, particularly if your first number is bright and good. It is a good plan to get fellows to put down the money for a year's numbers all at once, then you know where you are and about how many copies you will need. If it is a school magazine you are running, one of the masters will probably look after this side of the business.

A school magazine is generally run by an "editorial committee" of the senior boys. In this case, if you have anything to say in the matter, try to have the committee as small as possible. Three fellows who are really keen and who are chums will do better work than six, two or three of whom don't much care if the paper comes out or if it doesn't.

About advertisements. If you are lucky enough to be able to get local tradespeople to advertise in your magazine, you will be able to give more value than if you had to depend only on subscriptions to pay the printer's bill. If you have a cover—a cover of thicker, coloured paper—you will have the two back pages and the inside front page to let for advertisements. You will not be able to charge much for your space, of course.

POULTRY FOR BEGINNERS

BOTH in a villa garden and in the country poultry can be made very profitable by the boy fancier. The chief source of profit is, of course, the eggs laid by the birds, but it should also be remembered that many a good dinner may be reared.

Quite one of the latest methods of keeping hens is to shut them up in a closed-in house. This plan is called the "intensive" system, and one may keep many birds in quite a small house. From the hens' point of view it is almost a drawing-room existence, and it has proved itself to be exceedingly successful.

Later in this chapter a design is given for a suitable intensive house, as well as for other houses with outdoor runs, but there are separate types of birds for the different systems, and it will be well if we look at some of the breeds that are available.

Broadly, we can divide hens into two main classes—the heavy and the light. In the former class we have the Orpingtons (white, black, spangled and buff), Rhode Island Reds, Brahmas (very large), Plymouth Rocks, Wyandottes and Sussex. All the birds of this type require an open-air run and as much space as possible.

Boy fanciers making a beginning with poultry would be well advised to go in for Anconas. They are pretty little birds, with black and white plumage and yellow legs. Splendid layers, their eggs are large in size and white.

When poultry keeping in an intensive house the

floor should be covered to a depth of six inches with litter. This stuff may be composed of chopped straw, cedar wood litter, peat moss litter, dry leaves, sifted bonfire and household ashes, road sweepings if they are gritty, etc. The great point is not to have the litter too heavy, for you will want the birds to be scratching in it all day long.

Most fanciers place in their intensive houses a fresh supply of litter in September, allowing it to remain until March, when it can be dug into the garden as an exceedingly rich fertilizer. This litter *never smells* because it is always dust dry. When it is taken out in the spring and used in the garden fresh litter must be supplied, unless the birds are going to spend the summer out of doors.

The chief object of the intensive system is to encourage the production of eggs in winter time by keeping the birds always warm and dry. Their grain food is buried in the litter and they obtain sufficient exercise by scratching to find it. Another plan is to hang a cabbage from the ceiling by a string just above the heads of the birds so that they have to jump to peck it.

Apart from this, feeding poultry on the intensive system is much the same as feeding them under other conditions. As with most domestic creatures, change of diet is always welcomed.

According to the season of the year there are available for the feeding of poultry grain and meal of various kinds such as one buys at the cornshop. In addition, there is the vitally important green food for birds that are not kept on a grass run, in addition to all sorts of garden and household waste.

As a matter of fact, the few fowls likely to be kept by a boy or girl fancier can be largely fed upon house and garden scraps. Let us see what there will be available. In the first place, there are potato peelings and very small potatoes not fit for cooking ; there are the parings from other vegetables as well as those from fruit ; there are crusts of toast and bread ; the scrapings of piedishes ; the scraps left on the plate after a meal ; and the little meaty tit-bits that remain over after cooking. Instead of these things being thrown into the ash bin they may be turned to good account when one keeps a few hens.

By far the best plan is to set aside an old saucepan in which these odds and ends may be collected. Then, at the end of the day, the saucepan may be placed on the kitchen range and allowed to simmer, care being taken that sufficient water is first provided.

In the morning the contents of the saucepan should again be heated and then mixed with a little barley meal or sharps, to which double the quantity of bran or clover meal has been added. The whole may then be stirred and served hot in an earthenware dish, the mash being not too sloppy.

Such a breakfast as this is the finest food of all for laying hens, except during the few hot months of the year, when it may be dispensed with. In very cold weather, too, it is sometimes a good plan for a change to give the birds their hot meal last thing in the afternoon. As for meat scraps and the gravy produced from simmering bones (other than bacon bones) these are most beneficial ; in fact, without a little meat in some form or other laying hens can hardly be

expected to do their duty in the winter, and some fanciers buy scraps of waste meat from the butcher once a week for the purpose.

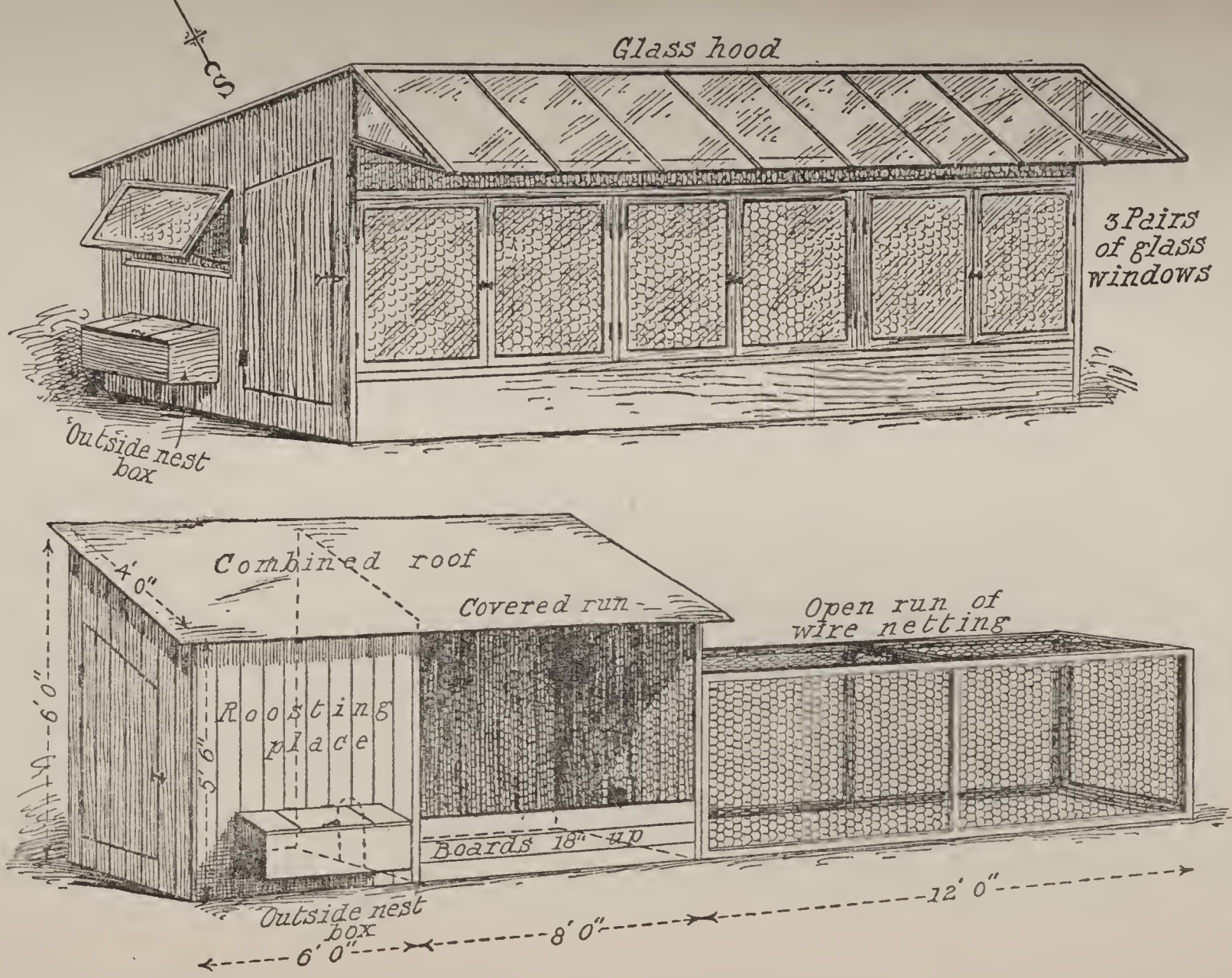
So much for the morning meal, which should be given regularly at a fixed time, the earlier the better. Much the same rules may be followed with birds kept intensively and those in the open.

For the midday meal, to be given about half-past twelve, there is nothing better than green food. According to season, the outside leaves of cabbages or lettuce, dandelions and other green weeds, lawn clippings and vegetable scraps from the house may be given.

The afternoon meal should consist of grain; except on those occasions when, for a change, the mash is provided. There are many varieties of grain food, wheat, oats, barley, maize and mixed poultry corn being the most common.

Wheat, oats and barley are all good and may be fed at different periods for variation. Maize is very heating, quite good in extremely cold weather or for a hen that is sitting, but not advisable as a general rule in any quantity for laying birds. Mixed corn makes a pleasant change now and again; but it should only be bought from a reliable tradesman, for often mere rubbish is mingled with it.

It will thus be seen that the birds require to be fed three times a day. On the question of water the greatest care is necessary. In the depth of winter it is an excellent plan to give the birds water from which the chill has been taken; and they must never be allowed to drink from a vessel partially frozen over. In the summer, the great point is to ensure a


Glass hood
3 Pairs of glass windows
Outside nest box
Combined roof
4' 0"
Covered run
Open run of wire netting
Roosting place
6' 0"
Boards 18" up
Outside nest box
6' 0"
8' 0"
12' 0"

supply of clean, pure drinking water twice a day and to *keep it out of the sun's rays.*

As to how much food to give the birds, no definite rule of quantity can be laid down ; but it is usual for more food to be given than is necessary by the amateur, so that the bird only suffers from kindness. Fowls require just as much food as they will greedily devour at a meal *and no more.* When food is lying about uncared-for a quarter of an hour after feeding time one is giving too much.

Bantams are splendid little fellows and can be made most profitable. They require to be fed on much the same lines as hens and are housed in the same way. The greatest profit is to be made by raising exhibition birds, and showing them ; but bantams lay quite well, a small egg that is very acceptable nevertheless. And as mother birds the little hens are quite reliable.

There are a great many varieties of the bantam, among them the black and white Rosecombs ; the Sebrights ; Game, and Pekins. To see them in all their glory, however, one should visit a poultry show and make the acquaintance of the several breeds at close quarters.

Ducks are exceedingly popular. A few may be kept in a run in a comparatively small garden, but these birds do best on an open grass range. It is not necessary, however, that they should have access to a pond or stream, and they thrive quite well without having the chance of a swim.

The most profitable variety of duck is the Indian Runner. It produces more eggs than any other domesticated bird ; sometimes more than 200 in a

year. The best plan is to buy a setting of duck's eggs at the end of March and arrange to borrow or buy a broody hen to hatch them. It takes four weeks for the eggs to hatch after the hen begins to set.

Runner ducks are white, buff or coloured, and they may be usually known by their erect carriage, rather like that of a penguin at first glance. Aylesbury ducks are much larger birds ; preferable to runners for table but not such good layers.

Geese should only be kept where they may be given on open run over field or common. In these circumstances they need but little feeding until the time comes to fatten them. The Emden and the Toulouse are the two best varieties.

Turkeys also require a good deal of space in which to roam ; but, in the opinion of some fanciers, they are more interesting than geese. The American mammoth-bronze is the largest variety, but the White Austrian is a very showy bird. Turkeys are fed in much the same way as fowls, except that when young they require a great deal more green food. They succeed best on light, gravel soil and do not prosper on ground composed of clay.

Pigeons make very pretty pets ; and, by selling the young birds, quite a handsome profit may be made by keeping them.

Very broadly, pigeons may be divided into two classes—those that fly long or short distances in competition with other pigeons, the racers among these birds, and those that stay about their home as pets.

From the point of view of boys and girls, the greater interest will probably arise from the keeping of carrier and homer pigeons. These birds, when they

have become thoroughly accustomed to their home, may be taken some distance away with the knowledge that they will return to their own loft.

The plan is, of course, to release them very carefully at first. Then gradually, as they become more used to their surroundings, they may have greater freedom and be taken farther away. The best way when starting to give a bird its liberty is to do so *before* feeding and to have a good meal on its return.

Other types of pigeons merge into the fancy classes, such as fantails, jacobins, and many others. In most districts there are fanciers' clubs that may be joined for small fees, and there is no better way of getting to know the points of birds, seeing that each society holds a show periodically.

Pigeons are not, generally speaking, difficult to feed. A common plan is to have a receptable known as a " hopper," which one fills with a suitable mixture of peas and grain sold ready prepared by the cornman. As the birds eat the food from the exit to this hopper, the grains fall and refill this saucer until the whole thing is empty.

A better plan, though, is to feed at regular intervals twice a day, morning and evening ; or late afternoon in the winter. Give the birds as much as they will eat at the meal and never allow food to lie about that it may get soiled and stale ; or, worse still, serve to encourage rats.

Fresh water for drinking is very important for pigeons, and, in addition, in all but the most bitter weather they will want clean water in a roomy earthenware or zinc pail or dish for the purpose of indulging in a morning bath.

HOW TO RUN A CLUB

IT does not matter what sort of a club it is, whether it is a football club, a cricket club, a stamp society, or a class or form association at school, if it is to be a success it must be run on proper businesslike lines.

When you are forming your club the first thing is to "convene a meeting" of all those who are likely to be interested in the objects you have in view. Usually several of you will have talked the matter over amongst yourselves, and know what it is you want to do. The best thing is to write out as many invitations as you think necessary, and send them round. The best form of invitation and "notice convening the meeting" is as follows:

"A meeting to discuss the formation of a Duddington Junior Football Club—or whatever the club is—will be held in the Village Hall on ..... at .... p.m. sharp. The presence of all interested persons is requested."

This should be signed by one of your number as "Honorary Secretary" pro tem., or by several of those who have decided to form the club. (Pro tem. is shortened Latin, and means "for the time.") Several copies should be written out on big sheets of paper, and stuck up in places where they can be seen. You will generally find that there are some local tradesmen who will be glad to help by displaying the notices in their shop windows. Of course, if you wish to confine membership of the club to your

own particular friends you will not display public notices, but will send the invitations to them alone.

Be businesslike from the very first. Make out an "Agenda," which is a list of business to be conducted at this first meeting. The Agenda should end with the paragraph "Any other business," to allow for bringing up anything that you have not thought of or allowed for.

Be punctual! Directly the hour for which the meeting is called has struck someone should get up and propose that So-and-So take the chair. This should be seconded and then put to the meeting by the proposer, who should say: "It has been proposed and seconded that Mr. So-and-So be the chairman of this meeting. All in favour please put up their hands. On the contrary. Carried." Or "carried unanimously" if no one disagrees. "Mr. So-and-So, it is the wish of the meeting that you should act as chairman, and I have pleasure in calling on you to take the chair."

The chairman is now in charge of the meeting, and his rulings must be obeyed if the meeting is to be orderly and not waste time. For chairman you need a fellow with some strength of character who will not stand any nonsense. The chairman does not vote on anything unless there is a tie, when he has a "casting vote," which gives victory to one side or the other. A strong chairman can often lead the meeting, though, on debatable points, particularly if he knows the ropes and what should be done.

The chairman's first duty after briefly thanking the meeting for electing him to the honour of the

chair, is to call on the honorary secretary, pro tem. to read the notice convening the meeting. This puts everything in order, and constitutes the meeting as a legal one for the purpose for which it was called.

Next the chairman, who has a copy of the agenda, calls on Mr. Somebody to move a resolution calling for the formation of the club. This should be something on these lines :

" Mr. Chairman, I have pleasure in moving that a club be formed to be known as the Duddington Junior Football Club, and that the objects of the said club shall be to encourage and provide facilities for the playing of the game of football amongst boys and young men residing in Duddington and within five miles thereof who are under the age of twenty-one years."

This kills two birds with one stone and saves time. Wording it like that you have the proposition, the name and the objects of the club all in one resolution.

Immediately the proposer has sat down another fellow rises and says :

" Mr. Chairman, I beg to second that motion."

The chairman then gets up and says his little say, which is in time-honoured form.

" It has been proposed by Mr. So-and-So and seconded by Mr. Thingummy that," and then he reads the motion, just as it was put by the proposer. " All in favour please put up their hands. On the contrary. Carried."

Of course, things may not begin so smoothly. There may be someone who disagrees with the name or the objects. The chairman should then listen to any speeches, keeping them as short as

possible, and, if the objectors want to do so, they should be allowed to propose and second an amendment to the original proposal. This should be put to the meeting before the original proposal, because once the original proposal has been carried it cannot be altered. By the carrying of the original proposal the name, the objects of the club, and any limiting conditions, such as age of members that have been included in it, are fixed, and can only be altered by the wish of the majority of the club.

The next business is to elect a small committee to get the club started. Do not be in a hurry to elect presidents and vice-presidents and captains and things like that. What you want to start is four or five earnest workers and an honorary secretary who really is keen on his job. They should be asked to draw up a set of rules for submitting to another general meeting in a week's time, together with any suggestions they may care to make for the proper running of the club.

The next job is to arrange your subscription, and appoint a treasurer. The honorary treasurer is an important man, quite as important as the secretary. He must be a businesslike fellow, whom you all trust absolutely. Make your subscription as small as you can, bearing in mind what you will have to buy, and whether you will have to hire a meeting room, playing ground, etc.

Collect as many subscriptions at the preliminary meeting as you possibly can. There is nothing like striking whilst the iron is hot. It is a good thing for the newly elected treasurer, when briefly thanking the meeting for their confidence, to announce that

he is prepared to take subscriptions right away, and that he will sit at the door when the meeting is over to "collar the oof." The treasurer should, from the first, make a point of giving a receipt from a stubbed receipt book for every penny he takes in, and demanding a receipt for every penny he pays out. That is the only way to keep the books straight.

You are now well on the way. Your club is properly constituted, and when, at the second general meeting, the rules, based on those of some well-established club, are passed, you can get to work.

If your club is for the playing of any games you will need a captain, whose duty it is to pick his team and instruct it and lead it to victory. The captain need not be the best player, though he should be good. He should be popular with the majority of members and yet strong. One thing is essential. The captain must be above suspicion of favouritism. Of course there will always be members who will criticize the captain adversely; but he should give such grumblers nothing to go on. Though to the rest of the club the captain should be a little king in all matters of team management, it will pay him to work hand in glove with the club committee, of which he should be an "ex-officio" member, which means that he sits on the committee by reason of his office, and is not specially elected to the committee by the general meeting of the club.

A useful little rule to have on your list is that the committee may "co-opt" members of the club to fill vacancies that may occur on the committee. Such co-opted members should only hold

office until the next general meeting of the club. It is a useful thing to have general meetings twice a year. The members of the committee should be elected to office for a year. It is a really good thing to have a rule that no member of the committee may serve for more than two years in succession. This prevents the government of the club from getting into the hands of a few members who may not represent the best talent. To make provision for this a quarter of the committee, those with the least votes, should automatically retire at the end of the first year without the option of re-election. The committee will always retire at the end of a year of office, and those who are eligible and who wish to serve again may offer themselves for re-election.

The secretary calls all meetings of the committee and the club. He should see that at least a week's notice is given of all committee meetings, and ten days' notice of all club meetings. He keeps the minute book, in which he writes an account of the proceedings at all committee meetings and all general and extraordinary meetings. The minute book should be written up carefully from notes taken at the meetings. It is a good tip for the secretary to write up his minute book the day after the meetings if he hasn't time to do it the same day. If it is left things are forgotten and trouble results. At every meeting, after the notice convening the meeting has been read, the chairman calls on the secretary to read the minutes of the last meeting. If they are approved he signs them and they are then a legal record of what happened.

The secretary's job is not an easy one. He must be popular as well as businesslike, for he has to see that all the members are happy and contented. On the secretary a good deal of the club's success depends.

The treasurer works very much in the background. Nobody pays much attention to him save when subscriptions become due; but his is a very important office for all that. We have already given some hints as to how he should run his job. He should keep all money, save a little for petty cash, in the bank, either the Post Office or a big bank, depending on the size of the club and the amount of money he has to handle. He should keep a book or books showing every penny that comes in and every penny that goes out. He should balance his accounts at least once a month, and keep the committee constantly informed as to how the finances are progressing.

An auditor should be appointed from amongst the general members of the club. Two auditors are better than one. You cannot be too careful in dealing with money, particularly with other people's money. At the end of the club year the auditors should prepare a balance-sheet showing exactly how the funds stand.

The president of the club is often only a figurehead, but there is no harm in getting as handsome a figurehead as you can manage. It is a good plan to get a popular local gentleman to act in this capacity.

The vice-presidents may be recruited from lesser lights and from members of the club who have done good work on the committee and whose interest

you do not wish to lose when it comes to the time for them to retire without the option of re-election.

This article has been written in general terms because, as we said at the beginning, all clubs are run on the same general lines. The smaller the club the less detail there will be to look after; but even if it is a club of only ten or a dozen members it pays to stick rigidly to the rules. In a small club the secretary may also be the treasurer. The team captain or the club captain should have no other office. He has quite enough to do without bothering about business details. Stamp societies and clubs of that kind do not need captains. The chairman or president is usually the high muck-a-muck in such cases.

The great thing about running a club is to find out your best workers and see that they have work to do. There are some fellows who like the honour of being an officer of a club but who are not prepared to work for the honour. That class of man you can do without. If you have any such specimens in office take the earliest opportunity of getting rid of them. The general members should remember that, if they think things are being done wrongly it does not serve any useful purpose to begin grousing and opening their mouths to all and sundry. The proper course is to talk quietly to members of the committee, and if that will not do the trick, and things are really wrong, to demand an extraordinary general meeting of the club.

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